

May 5, 1958

**Simulated Space  
Missions Reveal  
Crew Problems**

# Aviation Week

***Including Space Technology***

75 cents

A McGraw-Hill Publication

Lockheed CL-329, JetStar



**JetStar Fast, Versatile in Evaluation Flight**

## CONVAIR-Astronautics' ATLAS ...the free world's first ICBM

From Cape Canaveral came the news... CONVAIR AND THE AIR FORCE HAVE SUCCESSFULLY TEST-  
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armed the U. S. Air Force a vital weapon for our national security and a key to ultimate peace. The free world's  
first ICBM is now in pilot production at CONVAIR-Astronautics' plant in San Diego, California.

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## Now Available



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Operation of airborne hydraulic systems at 4000 psi is finding increasing favor because it means smaller components and less fluid in the system... resulting in an overall weight and space advantage.

Vickers 4000 psi hydraulic motors and fixed displacement pumps will also be available. For further information about 4000 psi pumps and motors, please write for Bulletin A-5259 or get in touch with the nearest Aero Hydraulic Division office listed below.

## VICKERS INCORPORATED

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|---|---|
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INC. N.Y.

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the Total Engineering Story



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## TRANS-SONICS

Precision Transducers

## AVIATION CALENDAR

(Continued from page 5)

- ment Meeting and Symposium for position, Hotel Statler, Los Angeles, Calif.
- June 5-15—Fourth International Symposium on Ionization and Gaseous Electronics, New York, N. Y.
- June 14-15—Second National Convention on Military Electronics Statistics Park Hotel, Washington, D. C.
- June 12-24—Sixth Annual Vibration Analysis Society for Airframe Structures, Hotel Statler, Boston, Mass.
- June 24-25—11th Meeting, American Industrial and Manufacturing Vibration Association, Hotel Statler, Boston, Mass.
- June 25-27—1st Transducer Conference, American Institute of Electrical Engineers, Hotel Statler, Buffalo, N. Y.
- June 27—First Transducer Symposium, first symposium sponsored by the Bureau of Aeronautics and Stevens Institute of Technology, Stevens Institute of Technology, Hoboken, N. J.
- July 4-6—4th National Aviation Exposition, Casino Argent, Pittsburgh, Pa.
- July 8-14—11th Institute of the Aeronautical Sciences National Summer Meeting, Aerobics Hotel, Los Angeles, Calif.
- July 14-15—Technical Symposium, National Aeronautics Association, National Aeronautics Association, Washington, D. C.
- July 20-21—11th Annual Symposium on Computer and Data Processing, Mayfield Hotel, Denver, Colo.
- Aug. 4-6—Special Technical Conference on New Laser Magnetron and Magnetron Applications sponsored by the American Institute of Electrical Engineers, Hotel Statler, Los Angeles, Calif.
- Aug. 19-19—Conference on Electronic Standards and Measurements National Bureau of Standards, Boulder, Colorado. Boulder, Colo. (sponsored by NBS American Institute of Electrical Engineers and Institute of Radio Engineers).
- Aug. 19-22—Western Electronic Show & Convention, Institute of Radio Engineers, Santa Monica Hotel, Los Angeles, Calif.
- Aug. 27-30—North Atlantic Convention, International Instrumentation Exhibition, Avionics, Bedford.
- Sept. 1-7-1958—London High Speed Display and Exhibition Society of British and Irish Contractors, London High Speed Display.
- Sept. 1-5—1958 Congress Engineering Conference, Massachusetts Institute of Technology, Cambridge, Mass.
- Sept. 8-14—National Aviation Show, Colorado Convention Center, Denver, Colo.
- Sept. 8-15—First International Congress of the Aeronautical Sciences, Palace Hotel, Madrid, Spain.
- Sept. 8-15—Dynamics of Flight, University of Michigan, Ann Arbor, Mich.
- Sept. 22-24-1958 Meeting, International Group on Television and Remote Control, American Hotel and Statler, New York, N. Y.

700°F

600°F

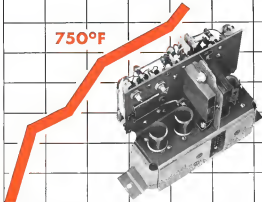
500°F

400°F

300°F

200°F

750°F



This General Electric designed and developed amplifier operates without the use of refrigerants at ambient temperatures from -67°F to 750°F.

## High-temperature, Radiation Tolerant Electronic Equipment—Without Refrigerants

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For information on how General Electric can help you solve your high-temperature electronic equip-

ment problems, contact your G.E. Missile and Ordnance Systems Department Field Sales Office or read the coupon below.

FOR MORE INFORMATION  
ON HOW TO MEET YOUR  
HIGH-TEMPERATURE REQUIREMENTS

GENERAL ELECTRIC COMPANY  
Section A23-6  
Electronic Division  
Schenectady, N.Y.

☐ Please send me Bulletin A23-6, "High Temperature Electronic Equipment."  
☐ I would appreciate a directory of my equipment to be furnished with General Electric High Temperature Equipment literature.

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1642... LVT (A) 1  
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1643... LVT 2  
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1644... LVT (A) 2  
Amphibious Personnel Cargo Carrier



1645... LVT 4  
Amphibious Personnel Cargo Carrier



1646... LVT (A) C  
Amphibious Personnel Assault Vehicle



1647... LVT 4 Lightweight  
Amphibious Personnel Cargo Carrier



1648... LVT (A) 3  
Amphibious Personnel Assault Vehicle



1649-1648-1000  
Amphibious Personnel Carrier



1654... LVT PB  
Amphibious Personnel Cargo Carrier



1655... LVTB-1  
Amphibious Vehicle for recovery duty



1657... M-54  
Amphibious Vehicle



1657... HAWK  
Mobile Launcher Vehicle



1658... THOR  
Transporter Launcher & Power Control Trailer

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**HAWK** Mobile launcher vehicle

**THOR** Transporter launcher & power control trailer

**REDSTONE** Transporter launcher

**NINE-HERCULES** Shipping and storage containers

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For data on this ad

**Typical Properties of Silastic LS-53**  
(cured 24 hours at 300 F)

|                                      |      |
|--------------------------------------|------|
| • Tensile strength, psi              | 1000 |
| • Elongation, %                      | 375  |
| • Compression set, %, 22 hrs @ 300 F | 35   |
| • Break Point, °F                    | -90  |
| • Solvent Resistance, % swell        | 0    |
| ASTM No. 3, 04, 23 days @ 300 F      | 10   |
| Jet Fuel JP-4, 15 days @ 220 F       | 10   |

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The new P&H engine-driven welders combine rugged, simple design with superior welding characteristics for long-life, low-cost welder operation. Elimination of non-essential parts and easy access to all adjustments simplify operation in the field — assure a self-contained source of dependable power for heavy construction, pipeline, maintenance, and repair welding. Other benefits include:

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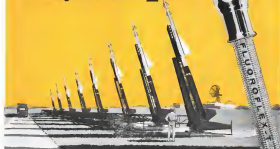


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THE VITAL DIFFERENCE

**Always ready for use**  
**Always reliable in use**



**Hot Aging**—ready for instant service at any time, whether measured by clock or calendar—that's medium and high pressure Fluoroflex®-T hose fabricated from a compound of Teflon® resin. Working life is enhanced for practical purposes.

**Permanent reliability** is assured by a manufacturer with complete control of hose production, as well as fitting and assembly fabrication. It is reinforced by use on virtually all liquid fuel and many solid fuel missiles produced to date ... proved by

years of in-flight service on military and commercial aircraft.

**Handles the most corrosive fluids** at temperature extremes, including the exotic fuels. Fluoroflex-T hose assemblies are ideal for use in launchers and fueling systems as well as in the fuel and hydraulic control systems—up to 5000 psi. Their slender silhouette and compact fittings conserve valuable space in standard missile envelopes.

**Vital Facts About Teflon.** Most properties of products made from Teflon

powder can change significantly with even minor or accidental alterations in processing. Your best guarantee of absolute reliability is the manufacturer's experience. Specify Fluoroflex-T for the hose that's backed by unequalled experience in fluorocarbon hose.



This 8-page manual's detailed information on Fluoroflex-T hose and hose components. It's available on request.

8 Fluoroflex and Resistoflex catalog (pg. 8-1) per set  
12 Fluoroflex-T catalog (pg. 12-1) Resistoflex catalog.

Originators of high temperature fluorocarbon hose assemblies

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CORPORATION

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unique control problem solved



The Waldorf Instrument Company's Fluid Systems Division recently undertook research and development activity on a unique control problem for aircraft gas turbine engines. It was required that a hydraulic unit be supplied which would provide the specified in-pulse vs. load pressure schedule and incorporate fuel interlock and over-ride mechanisms. A component package was designed which housed the following elements:

- HYDRAULIC BYPASS VALVE
- ROTARY POSITION SENSING MECHANISM
- HYDRAULIC STEP INPUT
- FUEL INTERLOCK VALVE
- AUTOMATIC FUEL PRESSURE OVER-RIDE
- FEEDBACK LEAKAGE MECHANISM

The control meets all requirements of military specification MIL E-8000A. This unit is designed to operate in an ambient temperature of -55° F. to 475° F. with surge oil temperatures of -65° F. to 425° F. at 3000 psi.

For further information, contact —



**WALDORF INSTRUMENT CO.**

FLUID SYSTEMS DIVISION  
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A DIVISION OF F. E. BENTON AND SONS



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DOUGLAS A4D-2 Skyhawk, smallest and lightest jet attack plane operates from all sizes of Navy carriers and short landing fields. Made possible the "Mighty Midget" this powerful business attack plane is the latest in design sophistication and efficient (aerodynamic) performance. Capabilities include carry-

ing atom bombs, rockets, missiles, machine guns and other weapons.

Menasco was chosen to fabricate the compact, lightweight, expand landing gear required to meet the highest performance specifications. Compatible with the design pattern, Menasco used the most economical, yet most effective and protected fabrication techniques to provide low cost high volume. This is typical of the imaginative thinking which applies to Menasco's production planning.



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SPECIALISTS IN AIRCRAFT LANDING GEAR



**REQUIRED:** A lightweight, low-loss, radiation-free cable with electrical uniformity for interconnecting the navigation and communication antenna circuits of the Douglas Aircraft Co.'s new DC-8 jet airliner.

## SPECIFIED: *Foamflex® Coaxial Cable*



A semi-flexible cable with tubular copper inner conductor, foamed polyethylene dielectric and commercially pure aluminum outer conductor.

With outstanding advantages for use in aircraft navigation, communication and warning circuits that include:

1. Twice the efficiency of solid dielectric (RG-8<sup>1</sup>/<sub>2</sub>) type of cable now in general use
2. Extended life characteristics that permit permanent installation and assure electrical stability during the life of the plane
3. Good frequency response over wide temperature variations, capable of withstanding highest summer ground temperatures, as well as extremely low temperatures found at high altitudes
4. Greater efficiency and improved system performance without the use of additional electronic components
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6. Lighter and smaller than many cables now installed in aircraft

Foamflex coaxial cable is supplied in long lengths on lightweight, disposable reels. For further information or inquiries, write Dept. FC.



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Dr. R. R. Keating, James Gordon (left) control who is now Associate Director for Development at NOL, observes research data obtained in experiments used for test.

## FROM UNDERSEAS TO OUTER SPACE—WEAPONS OF THE NAVAL ORNANCE LABORATORY GUARD OUR FREEDOM

Basic and applied research—and the development of advanced weapons for underwater, surface and air warfare—are the vital missions of the U. S. Naval Ordnance Laboratory near Silver Spring, Md.

Established in 1916 as a small experimental group to design sea mines and bombs, NOL has become one of the nation's most respected institutions for military research and development. There (thirteen divisions, including 1,000 scientists and engineers, work at its modern \$50-million facility.

In its forty years, the Laboratory has made many notable contributions to science and technology, and to our national defense. In World War II, sea-developed sea mines helped to strangle Japan's supply system. More recently, sea's work on torpedoes, missiles and rockets greatly speeded the development of these deadly weapons. The atomic depth charge weapon, conceived and perfected by NOL, has won five years, now provides the U. S. Fleet a means of defense against sudden enemy submarines.

Today, sea's work embraces virtually the entire field of advanced weapons design. One highlight is the

Laboratory's present key role in the development of rockets, the nuclear-capability missile that our scientists will soon be able to launch while submerged at sea. This is one of many new weapons first sea, in developing or testing with at present—weapons that are needed if the free world is to survive.

But in the long run, some of sea's other work is basic and applied research may be of even greater significance to mankind. For example, the advanced ocean-balance studies carried on at sea, which already have a solved some of the most vexing problems, may help unlock the remaining doors to interplanetary space travel. Or sea's work on advanced electricity may provide entirely new and better types of motors, generators and other advances. Or sea's basic research in physics and mathematics may furnish a key to the internal structure of subatomic particles, and open up whole new worlds for science and mankind.

Thus the Naval Ordnance Laboratory and our nation is now working by developing weapons that will ensure the survival of freedom, and by finding new scientific knowledge that will enrich our lives.



**FORD INSTRUMENT CO.**  
DIVISION OF SPERRY RAND CORPORATION

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Engineers at Ford Instrument Co. observe and test the progress of computer developed and built by Ford for the U. S. Navy's Bureau of Ordnance.

May 5, 1958

# Aviation Week

Including Space Technology

Vol. 68, No. 18  
Monday, May 5, 1958

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### Man's Scientific Space Role Debated

Panel at AROSS Aerospace Symposium questions whether man will be useful or merely "odd mole."

### Airlines May Face Military Traffic Loss

Defense officials forecast decrease of traffic if summer's proposal to drop discount is approved.

### JetStar Appears to Meet USAF Needs

Performance and characteristics indicate that Lockheed CL-329 fulfills USAF early aircraft requirements.

### SPACE TECHNOLOGY

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### EDITORIAL

Toward a National Space Policy 31

**COVER:** Second prototype Lockheed CL-329 JetStar is about to begin a series of extensive flight tests, including a nuclear-powered headquarter. JetStar was designed to fulfill USAF requirements for a fast, all-weather vehicle. Additional photos of the JetStar are included on the inside. Week pilot report on the second prototype beginning on page 76.

**COVER STORY:** The JetStar is a two-engine, high-speed, all-weather, nuclear-powered aircraft. It is designed to fulfill USAF requirements for a fast, all-weather vehicle. Additional photos of the JetStar are included on the inside. Week pilot report on the second prototype beginning on page 76.

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## CREATIVITY and PRODUCIBILITY

Basic research has been described as "a search for knowledge, unfettered by production demands." At Avco, we realize that fundamental new ideas cannot be programmed in advance to fit the needs of even the highest priority schedule. There will always be room here for this kind of basic creative work.

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*Robert D. Grange*

Robert D. Grange,  
Manager, Prototype Development Department



Robert D. Grange



Featured above in this new Research and Development Center are modern laboratories in Washington, Massachusetts. Scheduled for completion this year, the ultra-modern laboratory will house the scientific and technical staff of the Avco Research and Development Division.

Avco's new research division now offers unusual and exciting career opportunities for consistently qualified and forward-looking scientists and engineers.

Write to Dr. R. W. Johnson, Director of Technical Services,  
Avco Research and Development Division  
26 South Union Street, Lawrence, Massachusetts

**AVCO**  
Research & Advanced Development

## Washington Roundup

### Army and Industry

Army Ordnance, which includes the missile command, has taken another step toward increased industry participation in its annual review of weapons development. Security regulations are being revised to let almost any contractor or qualified technical group in the U.S. gain access to the Army's armaments of its future weapons and equipment requirements. Making more people familiar with the Army's advanced planning is expected to make the plans more realistic and eventually provide better weapons.

May Glen J. H. Thomsen, Chief of Ordnance, explained the new security procedures last week to a meeting of the American Ordnance Association. He stated simply that their purpose is to "create weapons development 'hot lines'." Such lines, he said, will only be established "when a man with vision as to how to solve an anticipated problem meets a man with the authority and power to carry it out and the solution is successful just at the time the problem becomes acute and very real."

### Senate Space Hearing

Senate Special Committee on Space and Aeronautics is scheduled to begin hearings tomorrow on the Administration proposal to create a national space agency with the National Aeronautics and Space Administration as its nucleus. James H. Doolittle, NACA chairman, will be the leadoff witness, according to Sen. Gordon Johnson (D-Vt.), committee chairman.

The House Committee on Aeronautics and Space Engineering is scheduled to conclude public hearings on the proposal on Wednesday and go on a seven-day session to work up the bill.

### Technology Act

Senate hearings on the proposed Science and Technology Act of 1958, which began last week, will be limited to consideration of a program for construction of scientific and technical information. Sen. Robert Thompson (D-Miss.) chairman of the Reorganization Subcommittee of the Senate Government Operations Committee, said initial test provisions of his proposed act are under consideration in the Committee on Aeronautics and Space and will be deferred until a coordinated program can be satisfactorily worked out between the two committees.

Current phase of the hearings will be to develop an inventory as to the need for further legislation to carry out the government to establish a program to secure adequate dissemination of scientific and technical information.

### Small Business

Defense Department negotiations have given Senate Small Business Committee an optimistic picture of the possibility of substantial participation in small firms in the rebuilding of military, nuclear and space programs as subcontractors. But this anticipated trend may have suffered from as price controls. Tomlinson McGee, Assistant Secretary of Defense for Supply and Logistics, reported that about 10% of the orders paid to prime outside contractors now flow to small business subcontractors in the last tier. May Cies Allen Press, deputy Air Force director of Military Materiel, put the USAF percentage slightly higher and estimated that an additional 7% of the overall dollars for military goods is available to small business subcontractors.

Small Business Committee.

Aircraft Industries Association reported last week that of the 51 billion paid to subcontractors of the aircraft industry engaged in military work during 1957, more than \$187 million—approximately 21%—was paid out to small business subcontractors. NACA said that the small business share of the total should be somewhat larger in military areas into production phase of the program.

### Pay Increase

Both the House and Senate have approved "increased" military pay increases but differ on the amount necessary to attract and retain a career force. A career force, committee men have agreed to work this out.

The House approved a measure that would provide \$681,000,000 annually in pay to the military. The Senate bill that would cost a total of \$577,000,000. The lag between was prompted after recommitment of the Senate Committee and is designed to keep trained and qualified personnel in the armed services. The bill provides heavy increases for top officers and enlisted men and adds new grades to the lowest career categories.

### CAB Red Tape

There is a move to reform Civil Aeronautics Board and type by eliminating non-essential hearings. For example, one procedure or more of a small number of aircraft. Legislation authorizing the Board to do this has been introduced by Sen. Warren Magnuson (D-Wash.), chairman of the Senate Commerce Committee, and Rep. Owen Harris (D-Ark.), chairman of the House Commerce Committee. Magnuson estimates that the legislation could eliminate 10 or more of 10 hearings each year which are now required to be conducted at considerable expense in terms of time, effort and money expended by the Board's staff and be the applicants.

### National Air Museum

Proposals to create a National Air Museum in Washington are expected to be considered in executive session within the next future in the Senate. Public Works Committee and Commerce Subcommittee on Aeronautics Chairman Sen. Pat McClellan (D-Mich.), public hearings have already been held.

### Airport Design

Civil Aeronautics Administration last week named the firm of Aronson and Whittier, New York, engineering consultants to design the new Washington International Airport at Chantilly, Va.

Bennett Griffin, recently retired director of the Washington National Airport, has been appointed special assistant to the chief architect in charge of the program of the new Washington International Airport. Griffin will be assisted by Howard Nader, Townsend and Bradfield, Illinois engineering consultants retained by the Miami Port Authority.

The Washington terminal building, control tower and service buildings will be designed by Eric Suman, Washington architect. Bennett and McGowan of Kansas City will design electrical installations at the new Washington airport and Elton Blasted of Washington will be the master planning consultant.

—Washington staff



that separation of ions is needed, with separate plasma being neutral, while an ion rocket accelerates a charged mass.

Device producing acceleration used to meet their requirements for electro-magnetic acceleration of a gas.

• Production of uniformly spaced gas in the axial stage of acceleration process to provide uniform current in the gas.

• Continuation of gas sample behind shock wave to eliminate losses to reflection.

• Acceleration over extremely long distances to provide enough time for a strong magnetic field to build up to furnish the accelerating force.

Major portion of weight of magnetic field magnet is made up of the state of the capacitor from which the discharge current, Patrick pointed out. Calculations indicate that magnetic field must have low inductance characteristic to be an ion rocket motor proposed by Dr. Ernest Strehlitz (for trip to Mars), when operating at conditions where exhaust velocity is 120 km per sec.

#### Thrust Experiments

Technician thrust experiments supported by allied experimental and analytical research indicates that the plasma rocket can be one of the most powerful propulsion systems for space vehicles, according to D. P. Howard, General Research Laboratory. Although experiments have been made on rocket models, it has been found that the most efficient specific impulse can be obtained with an electric arc plasma generator, Howard pointed out, adding that it is reasonable to expect that further research will lead to the development of powerful magnetic drives required. Specific impulse of 500 sec has been obtained with argon, substituting for atmosphere.

Concerning the thermal-to-electric conversion, Howard declared that it is highly doubtful that a plasma rocket will ever take off the surface of the earth. He said it is reasonable to expect that the plasma rocket will be a type of propulsion of interest in certain space missions originating and terminating at satellites.

Plasma generator itself probably will be the most suitable component on a plasma rocket. Problems there in the reliability category undoubtedly will be found in the electrical supply and control system, Howard indicated.

With plasma generation using argon as the working fluid, first stage of low-draw operation can be expected once experiments with helium and hydrogen are accomplished, Howard said, but indications are that new design concepts will be necessary to achieve acceptable life with these lighter gases.

#### ROCKET COMPARISONS

Nuclear rocket appears most suitable for variable gas space travel, according to F. G. Lee and K. P. Cornell, of Aerojet-General Corp. Laboratory, Azusa. One of the nuclear rocket, equipped with attainable high specific thrust values, makes it a unique propulsion system capable of take-off, landing and space travel, they said.

In general, chemical rockets using either solid or liquid propellants are not suitable for propulsion in space, but in certain specific cases a propulsive system using solid propellant appears feasible and may represent the most suitable system.

Protonic space propulsion systems should utilize planetary atmosphere as one of their energy sources, it was indicated.

Investigations show that a room-temperature engine with alternating will increase values of thrust per unit frontal area and engine specific thrust.

General relationship of ions for propulsion would result in improvement in specific impulse of an order of magnitude greater than that attainable from chemical propellants, nuclear rocket and ionization engines, Lee and Cornell indicated. To obtain a potential ion propulsion system, major problems in area of high-speed ion sources and lightweight power supplies must be resolved, they pointed out. Propulsion calculations based on present technology show that ion acceleration of an ion propulsion system is of the order of one-thirtieth G. Comparison of orbital and altitude types of guidance undoubtedly will prove to be the most important if not the only means of guiding the space vehicle in interplanetary travel, Lee and Cornell said, at least on the near-term phase of this type of engine.

#### MARS PHOTO-RECON

Feasibility study of a three-year, continuous photo-reconnaissance mission to Mars was analyzed by J. H. McCann, James E. H. Jones, J. Frey and William S. Kuyper, Massachusetts Institute of Technology's Information Systems Laboratory.

If a scientific and development program was authorized today, they said, a vehicle could be in launch orbit five to seven years. Well-balanced, intelligent mission design based on known techniques should permit the mission to be accomplished with a reasonable probability of success.

Major problems of navigation would be handled with a coast-tracking telescope and another telescope to track stars and planets.

Rotating airbrake would turn a given radiator to put the sun in shadow and keep it there. Single sun gyroscope would keep the vehicle oriented.

Using the sun's own orbit, the star-tracker required no target. Penetration of a hydrographic ground passage through a variety of obstacles, the star-tracker to control the vehicle's attitude through use of the Beveland Obolenski box also would be controlled in part by solar sensor and a lower power propulsion system for supplying attitude correction data.

Viewing telescope with camera at 2000 miles would have a 5-in. aperture, 20-in. focal length, and would see 1000 ft. at 1000 miles, giving 500-ft. resolution at a distance of 4,000 miles.

Paralax observations of heliostatic vehicle and low thrust vehicle, such as ion-propelled rocket ship, as compared to Mars, was completed by Dr. E. K. Hines, Space Technology Laboratories, Ramo-Woodbridge Corp. Both vehicles start from 100 mi. circular orbit about earth, with low-thrust vehicle being inside and orbit elliptic vehicle outside. Mars on an ellipse which depends on time adjusted to trip. Low thrust vehicle, powered all the way, first escapes from earth on a spiral orbit, then follows an approach trajectory that turns about Mars, since later parking velocity of Mars. Each vehicle enters an elliptic orbit about Mars. On returning to earth, final descent velocity equal to Mars' escape velocity. The return is accomplished using aerodynamic deceleration.

For the same travel time, low-thrust vehicle being powered supply requires 100 times the 300 horsepower of low-thrust of solid power is about equivalent in power capability to the best chemically propelled ballistic vehicles. Low thrust vehicle supply using batteries and 70 horsepower per kilowatt performance is about equal to that of ballistic vehicle using hydrogen boosted by nuclear motor.

If the weight of power supply can be reduced to one to 10 kilograms per kilowatt, payloads of over 50% of vehicle weight can be carried even on roundtrips to Mars, taking only four to six months into travel time, Hines and Hines concluded.

#### SPACE BOOSTERS

Launching of space vehicles by air-breathing lift-off stage was outlined by Anthony Fess, Politechnic Institute of Brooklyn, and Louis Fiddlers and Walter Dirlan, General Atomics Laboratories Inc. By using lifting air-breathing lift-off stage, a propulsion system, thrust mechanism can be reduced, and time left means flight in atmosphere, propulsion by an air-breathing engine is logical. Advantages for vehicle include:

- Specific impulse is increased by an order of magnitude.
- Flexible launching site is afforded,

large fixed and expensive ground installation are eliminated.

• Fast stage is recoverable and reusable, increasing in repetitive operations such as launching a variety of satellites without modification and in building space stations.

• Fast stage usually is largest and recovers payload capacity.

• Reliability is high.

It will be possible to launch a 10,000-lb. payload-5,000 lb. payload-into high altitude orbit using super-sonic aircraft, new technology, Hines said, and 15,000-lb. thrust rockets.

Conventional all-rocket system would have somewhat lighter initial weight than the air-breathing arrangement and would require rocket launch systems with thrust of about 1,000,000 lb.

Mars which can be put into orbit in a given rocket system substantially with launch Mach number. As launch speed is increased beyond Mach 5, its basic disadvantage is through the dissipation of large rocket engines.

Thrust operation with J44 was incorporated for speeds up to Mach 4 and dual cycle engines were used at Mach 4 and Mach 5, with maximum velocity to target and trajectory fixed at Mach 17.

#### RE-ENTRY

Disturbances between satellite and heliostatic vehicle, as can be pointed out by Frederick Rabel, chief of Design, of Aero Manufacturing Corp.'s Research Laboratory Division, Scituate, in general, experience much lower deceleration, lower heat dissipation and heating time, even over an order of magnitude longer than for a ballistic missile.

Also, the significant heating occurs at higher altitudes for re-entering heliostatic

and this gives lower heating rates but higher total heat inputs.

Scituate, a jet is acceptable in both respects to limit additional methods for landing on other bodies, but lower heating rates in heliostatic reentry suggest use of isolating surfaces for heat disposal.

#### LUNAR TRACKING

Improvement method for optical, following lunar vehicle trajectory is afforded by 10-ft. mechanical heliostatic system at various points along the path, according to N. H. Johnson, director, electronics and physics, Astronautics Services Inc. At lunar distance, the type of reflecting heliostatic illumination is the sun appears as a 17th magnitude star, visible in 45 in. telescope. A 40-in. heliostatic with three and a half mechanisms will weigh about 70 lb.

If number of heliostats are released along the trajectory, precision of sun light motion acceleration of about 0.02 microns per sec. which equates to the heliostats launched a day apart by 1,000 km. To follow vehicle trajectory, moon should be at first or third quarter, with sun within 45 degrees in path, perpendicular to line of sight. With a number of heliostats, it would not be difficult in extrapolating the vehicle's angular position in desired accuracy.

This heliostatic bearing is one method of finding exact position of the vehicle. The moon, as also will be a number of the heliostats.

Method of measuring moon's radiation from the advantage that assuming in measurement because radiation received by heliostats increases counter arrangement is proportional to solid angle subtended by moon at the center and whatever the orientation of the vehicle.

Additional test on loss motion were the moon could be supplied by vehicle-borne. Display, and solid state could measure the moon's active surface velocity and distance. Also, pair of laser interferes could take telephoto or television pictures of each other with background of stars behind to provide reference grid.

Other measurements Bureau suggested included the moon's magnetic field, structure of atmosphere, distance from part of sun's "atmosphere," as traced by the moon's gravitational field together with determination of composition, density and temperature of the atmosphere, moon, and around moon position, its pressure and temperature.

Among test engineering questions which will be partially answered by this exploration are best locations for landing instruments-carrying vehicles, land use and habitation, resources, atmosphere and mineral and oceanic materials, bases, if prehabilitated. Other answers would be best sources of water and oxygen bearing rocks, water minerals, and lunar wind materials.

#### Navy Chooses Electro

Lockheed Electropropulsion aircraft has been selected by U.S. Navy for use in air-submarine warfare program, after evaluation of "terrestrial" other aircraft.

Step and a search and development contract with Lockheed Aerojet Corp. will be completed shortly for a medium model and further studies. The aircraft will carry a crew of 16 men and considerable electronic instrumentation. Electro, which will replace Lockheed F4V Phantom, is powered by four Allison T56 turboprop engines each developing 4,000 hp (AWM No. 5, p. 44).

Contract also above background is presently progressing to report of the director to navy.

#### LUNAR PROBLEMS

Scientific and engineering lunar exploration factors were outlined by Dr. John L. Barnum, Systems Corp. of Anaheim. Present lunar trajectories require a range pattern and stable value of lunar mass, then present value with its associated mass, and orbital accuracy.

Harold Goodwin, by suggestions engine changes from a lunar satellite, could be recovered through 100 in. earth telescope to supply data. To pick up light of explosion on the moon's surface through the telescope, a matrix of photomultipliers only with individual is needed might be used as a detector. Background light selected from lunar mass, then selected, then then increased in light intensity as measured and mapped on grid centered by the telescope at the pericenter time.

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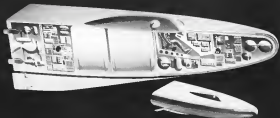
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Republic Displays Nose Cones

New cones on display at Republic Aerospace Corp., where they are produced under contract from General Motors Co., are designed for use on Thor IRBM's. Cone fitted is not at right angle to the only part that actually does no complete mission. Structure at the left is the airbrake. One in the center (part behind models of Thor and Atlas) is command nose. The nose reentry vehicle will be on the Atlas.



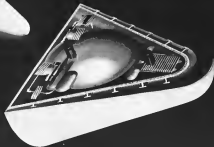
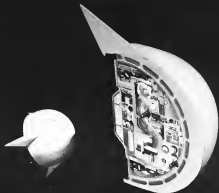
#### SPACE TECHNOLOGY

## NACA Proposes Satellites Capable of Piloted Re-entry

National Advisory Committee for Aeronautics delta wing satellite proposal (above left) would have blunt nose and blunt, highly swept wing and its leading edges to reduce aerodynamic heating. It would land fully conventionally, compared with other heat satellite (above right) and would have greater flexibility in choice of landing area. (Other heat could land on water.) Delta wing would be subjected to more heating, especially at nose and wing leading edges. Both vehicles would have ramjets for maneuvering during reentry and landing, would operate at high angles of attack,

and would be radiation-cooled. Reentry legs make vector in reentry heat, motion in delta wing, give fast stage boost to stabilize speed, small retro-rockets initiate reentry. Reentry jets give space stabilization, individual components are landed for independent study in atmosphere. Pilot sits in conventional position since reentry deceleration should not exceed 2Gs. Hemisphere proposal (below left) has heat shield of ramjet-cooled reentry and heat sink design. Beryllium oxide outer shell is supported from inner capsule, which is heat-insulated by insulation. Heat sinks

180 deg., normally in pilot air, adjust wall to resist maximum 5G deceleration forces. Internal equipment includes research and flight instrumentation and observation gear. Reentry shield of vehicle's base is for low speed, low altitude. Retro-rockets to slow reentry. Five cylindrical vehicle for constant reentry. Ballistic vehicle (below right) has copper shell heat shield that is ablated in nose. Air gap and insulation separate shell from inner capsule. Piloted is located reflectively in forward to expand to secure stability of vehicle during atmospheric reentry.





## Doolittle Urges Adoption of Plan For Civil Control of Space Agency

By Fred Eberhart

Washington—Civilian control of the nation's space program is necessary, if major objectives are to be accomplished, James H. Doolittle, chairman of the National Advisory Committee for Aeronautics, told Congress last week.

Doolittle appeared before the House Committee on Aeronautics and Space Exploration in testimony in support of the Administration proposal to create a National Aeronautics and Space Agency with NASA as its nucleus.

"It would be difficult or impossible for the nation to fully accomplish its space objectives if the program were under strictly military control," Doolittle said. "Direction and leadership of the program must be the responsibility of a civilian agency as provided in the bill, with the necessary provision that there must be effective cooperation and coordination between civil and military space work."

Doolittle said the committee that drew these proposals of civilian military control, which it is now studying, and still often met in each direction.

### Military vs. Civil

He explained that scientific and reconnaissance satellites are strictly civilian projects, while various satellites and highly sophisticated radars sent into space to gather scientific data would be in civilian projects. Weather and reconnaissance satellites are examples of projects that have both civilian and military application.

Doolittle attacked the committee that gave projects of a military nature civil control with the Defense Department even though NASA would depend upon military hardware, for the time being at least, to get its civilian program into space. He also said he thought the military services should be permitted to continue some basic research in the space field on a coordinated basis.

"NASA, by cooperating with and coordinating the efforts of all concerned in a national space program," Doolittle said, "can do a better job more quickly and cheaper than separate agencies."

Earlier, testimony indicated that there left several of the space program should be in a civilian agency, but it was noted that the military services must play a greater role and that military would be given priority over civilian scientific exploration.

An NACA spokesman told Eberhart

Watts that the proposed legislation does not eliminate the military services from an active role in space exploration in addition to civilian development. He said NASA could conduct joint programs such as the X-15 program now made with the Air Force, Navy, and NACA participating.

### Public Participation

Meanwhile, Ray James G. Fisher (R Pa.), a member of the House Space Committee, suggested that a committee of five members made up of the Air Force, Army, Navy, and NACA participate.

He said the five-member committee should be composed of the "right civilian" and proposed the following members:

- Dr. Lee DeBakey, president of the California Institute of Technology in Pasadena of the committee.
- Rear Adm. Hiram G. Rickover, in command of the Naval Shipyard, for the nuclear propulsion.

### No Space 'Stunts'

Washington—Proposals to send rockets to the moon should be made a part of an overall national space program and not designed as a "one shot," James H. Doolittle warned the House Committee on Aeronautics and Space Exploration last week.

The chairman of the National Advisory Committee for Aeronautics and that killing the moon with nuclear explosions as "first step" would constitute a "stunt," he said, warning that the nation should not be exposed with scientific setbacks.

Doolittle said projects of a National Space Program, including, perhaps, should be designed to further two goals: (1) Sending highly instrumented vehicles into space that will send back, or bring back, the new knowledge that constitutes most of the sending into space, and (2) Sending man into space on a voyage of discovery, but not least how to bring them back alive.

"In my program, we should keep our eyes focused on these objectives," he said. "The fact that the mission may involve some specific objectives in their space program, first should not be permitted to divert us from our own designated objectives."

• Rear Adm. J. T. Harwood, assistant chief of staff operations for research and development.

• Dr. Hugh L. Dryden, director of National Advisory Committee for Aeronautics.

• Dr. Herbert F. York, chief scientist, Advanced Research Projects Agency.

In his testimony, Doolittle strongly defended the proposal to create a three- and 17-year board to lead the agency as opposed to the commission plan.

He advocated the simplest board possible that will still provide adequate representation of all of the agencies involved. A board of less than 17 would not provide adequate representation and a larger board would be cumbersome, he said.

Doolittle added he favored agencies from all three military services on the board in addition to one from the Defense Department, AEC, National Science Foundation and the National Academy of Sciences in addition to civilian representatives.

The NACA chairman said it also is necessary that human be maintained at all levels, much in the same manner as the present fusion between NACA, the military services and civilian agencies.

### 'Decision Committee'

In addition, he suggested that it might be feasible at a later date to create a "Decision Committee" to give out any guidelines that might arise. He said the committee should be composed of the President's science adviser, the NACA director, a Defense Department representative, the AEC chairman and the National Science Foundation director.

John W. McCone, (D Miss) committee chairman, said Doolittle's plan for the space program was "unfortunate" about creating a civilian space agency but that as more testimony appeared his confidence would be.

During hearing last, however, an emphasis to look to the original bill, McCone said.

Dr. Walter R. Doolittle, technical assistant to the president of Bell Aircraft Corp., suggested to the committee that it should not set up a space office with a person with the equivalent rank of the U.S. vice president in order to place it on a higher level. He also suggested the Administration proposal to create a board that will lead the effort to develop a new space office not to run projects.

NASA, he said, should serve as a basic and applied research body and not serve as a staff as well as the military.

## Furnas Urges Broader NASA Authority

Denver—National Aeronautics and Space Agency should have expanded authority and broadened policies for the support of research to include sciences even that now held by National Advisory Committee for Aeronautics, Dr. Clifford G. Furnas said last week.

Furnas, chairman of the University of Buffalo and former Assistant Secretary of Defense for Research and Development, expressed his views on NASA and Defense Department reorganization at the second annual Air Force Office of Scientific Research Administration Symposium. He said he believed with NACA as a nucleus for NASA is "the easiest idea" but that NASA should have broader control powers.

"Outside areas of scientific research laboratories on universities, research institutes and some industries should be supported by contributing scientific knowledge to the multifaceted problems of space," Furnas said.

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### Inherent Dangers

If this aspect is not adequately handled, the national program will be greatly weakened. There is shown the tendency, even if not the intent, for large government organizations to become monopolistic," he said.

This leads to the great blocks of talent, new ideas and appropriate competition. Further, it results, through the restriction of man power from which future progress must be drawn. It must that adequate attention be given to this important matter."

Furnas also called the question of how to the military establishment should go in conducting or supporting research in the space or outer space character in the general field of space technology" if NASA is established. He said he could see "some very old arguments being started off and put out on a regular basis, the one that the military should not "double in scientific type."

"More than any other, the military establishment should apply all possible knowledge and should develop a philosophy of including the one that the military should not "double in scientific type."

"If this is being adequately handled by the military, the military should be able to do with new problems of which there will never be a shortage."

"As a practical matter, it is a

matter to get financial support for a project under the military direction, particularly if the task requires an large, than it is for a civilian agency. As a nation to should push forward to get the necessary job done through what was already in place."

Grant cost of space exploration will not be "seven more millions than ever to achieve a task adequate coordination between military and civilian programs."

Reorganization of the Defense Department "can be a last ditch in achieving the desirable pattern of action," Furnas said.

"The anticipated changes in the scientific and development area is a good step in the right direction."

### Defense Reorganization

Two important aspects of this part of reorganization he said, are:

- Defense reorganization should have a higher rank, and were well defined authority than the present Assistant Secretary of Research and Engineering.
- This official will have at his com-

mand, and available, civilian funds and technical services, which will permit him to initiate and conduct important research projects, particularly those which are of potential benefit to all three services.

The bill gives him a positive and constructive control which has been almost completely missing in the Assistant Secretary's office in the past. At the present, the Assistant Secretary office has only negative control.

Some fear that this would lead to "too much centralization of power" and loss of enough among competitors, Furnas said. Some competition is desirable, he added, "but not the weakness which is what has been exposed to that such some degree. Even a healthy game needs a set of enforceable rules and an effective referee."

Furnas' remark tried "How High the Moon?" He said that question cannot be answered, but it is a very serious effort. "The challenge is to get our new immediate civilian working and for civilian human science, it is highly important that we get them and beyond."

## Blue Streak IBM Tests Speeded

British Blue Streak intercontinental ballistic missile is now nearing the ultimate test stage.

Major developments of the Blue Streak missile, which is designed for launching from underground sites, have already been tested at completed flight tests. New test series are rapidly being conducted for the next development phase.

Prime contractor for Blue Streak is the British firm IBM, which is also responsible for the European launch vehicle, which is under development.

• Dr. Harold A. Smith, U.S. Air Force, responsible for the research and development of the Blue Streak missile.

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negative tests of the Blue Streak missile by Saunders-Roe at a remote location on the Isle of Wight. The Saunders-Roe missile is the first of the Blue Streak missile.

Koff Raver is building a rocket on the test stand at Spaldenham, Wiltshire, Cumberland, for static testing of the engines and propulsion system development.

Completed models will be fired on the extended test range at Woomera, Australia.

Development of the British IBM is being coordinated with similar programs in the U.S. Considered of information between the British program and USAF's Project Minuteman, also based on an underground launching capability, is expected to lead ultimately.

Lack of facilities in Britain for basic development studies in the approach speed stage may necessitate one of a transatlantic surface and/or reentry vehicle after launch on U.S. range or supplied directly to one of the American firms doing the work. The example General Electric's low-angle nose cone developed for the Douglas Thor could be adapted to Blue Streak. Technical interchange agreements in the high speed field already exist between General Electric and Dr. Harold A. Smith, and possibly could make be extended to cover some other items.





**first ... plane to land at the South Pole**  
**place ... Operation Deepfreeze II**  
**heater ... Herman Nelson, of course**



The first aircraft ever to land at the South Pole—and the first Americans to set foot at the South Pole . . . these were history-making feats achieved by Operation Deepfreeze II. The mission was carried out on October 31, 1966, by a party and crew of seven men in this Navy I-4D. Naturally, Herman Nelson Portable Heaters were chosen as support equipment for this important mission, providing quick, reliable heat. Herman Nelson's 26 years of experience in the portable heating and ventilating field can be put to work on your problem.

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**NORTHROP** Southrop's proposal for a recoverable manned space laboratory would be based on a bullet-shaped capsule 7 ft dia. and 30 ft. long to be launched by existing KSRM

## Manned Space Laboratory Plan Based on Bullet-Shaped Capsule

Los Angeles—Northrop Aircraft's plan for a recoverable manned space laboratory, which could be put into a 700 to 1500 mi altitude orbit within three years, was outlined here last week. George Douglas, vice president-engineering Northrop Division and one person has developed basic design criteria for a perfectly fusible manned space laboratory.

Bullet-shaped capsule approximately 7 ft dia and 16 ft long with nose tapered round, would possibly be launched by existing air-to-air-to-air ballistic missile coupled with a Polaris for additional stage. Capsule would weigh about one ton and would have a payload of approximately 1,000 lb. Missions capsule would be in a east-south position to withstand forces of acceleration and deceleration. Equipment for an air conditioning, communications, navigation, stabilization, restraint devices, and all other functions necessary for the trip are included in capsule.

None of capsule contents reverse thrust would be fired at a point about 150 deg. from landing point, would change capsule attitude so it would land on blast end. During launch, pointed end of capsule would be forward to reduce drag and would also position nose to be used with stand acceleration from time first to last. After obtaining orbit, capsule would make several revolutions until

event position would be determined by tracking stations. Then thrust jets acting on capsule from stagnation area, would turn capsule to blast end forward position. Navigation system would be a star-tracking system similar to one developed by Northrop for Starc missile.

Firing of reverse thrust rocket would reduce velocity so that capsule would go into elliptical orbit with lowest point being earth's surface. Capsule would re-enter the atmosphere at a shallow

angle (about 2 deg.) keeping heating rate and deceleration at acceptable levels. High drag on blunt end forward attitude would slow capsule from 25,000 fpm to 1,000 fpm (Mach 1) by the time it had descended to 60,000 ft altitude. Capsule parachute would open at 30,000 to 50,000 ft to assure gentle landing.

Northrop feels that one of the more critical problems is controlling stress of vehicle to earth. Reverse thrust rockets must be controlled very accurately as well as velocity, at end of reverse thrust, direction of thrust and timing to correct when to descend into air.

Recent problems are much the same as those of a bullet-shaped capsule aerodynamic heating and deceleration. However, Northrop feels that by reentering at low angle with high drag, it can limit the maximum surface temperature to about 1,500° and deceleration to about 8G. Temperature inside capsule could rise only slightly since maximum would occur for only about one minute and man's G tolerance would not be exceeded.

Thinner program would include unmanned flights prior to launching man-first with instrumentation only, then with animals.

Northrop's Advanced Design Department is active in several open projects, according to Douglas. Company has conducted numerous studies in field of astronautics and has received training knowledge and projected theories in this field over the past 24 yrs.

Douglas envisioned that manned satellite program is proposed as a new step before specific satellite vehicles can be developed for use in outer space. He believes that the currently advanced programs of space and lunar stations for strategic bombing and reconnaissance must not be allowed to divert men and money from the development of today's aircraft and missiles.

## Computing Center Gets Equipment

Full complement of mathematical and resolution equipment has been assembled for Northrop's Computing and Distribution Center, Compucenter, where announcements are made of the company's studies leading to the capsule program.

Analogue equipment capable of simulation and model testing is provided as well as analog calibration, digital calculation and data handling.

Another part of Compucenter is devoted to studies of new methods and machinery which will further computation, data handling and resolution.

Compucenter currently operates on IBM 704 digital computer, plans to install an IBM 709 in the future.

## British to Order Additional P.I.B.s

Additional production order for the Republic of Ireland's P.I.B. fighters and a training version will be placed "as necessary" to ensure continuity of production, British Minister of Supply Andrew Gwynedd has announced.

Extension of the total number of all British-supplied fighters to be built plus the quantity of about 150 including both types.

Two-seat trainer has a side-by-side seat, looking at a possible operational role. It is a single-engine fighter in use of its own capacity and its own operation. Aircraft is scheduled to fly in 1970.

# Opposition Grows to Reorganization Plan

By Robert H. Cook

Washington—Congressional opposition to President Eisenhower's controversial proposal for reorganization of the Defense Department intensified last week, following a reluctant refusal by the President to alter the bill in line with views expressed by the House Armed Services Committee.

Congressmen feared that the Administration might "lead us into" realignment by Secretary of Defense Neil H. McElroy, who was not "available" to the language of the proposal. Alarming that he would have performed some task in office before becoming involved with the plan, McElroy said "there is an opportunity here for a good deal of useful working out of language."

The President himself, has twice stated that there will be "no retreat from... or compromise in" the essentials of his bill.

Opposition to the Administration plan is following a line of attack that the proposal, if adopted, would place the future of the nation in the hands of a "military czar" and a "bureaucratic czar" and a "bureaucratic czar" would control all Government internal actions that expand the powers of the Secretary of Defense and increase the size of the existing Joint Chiefs of Staff.

Congressmen also fear that the present wording of the bill might eventually be interpreted to bring about a possible merger, or even elimination, of service branches under the guise of unified commands.

Secretary McElroy, Gen. Nathan F. Twining, chairman of the Joint Chiefs of Staff, Gen. Merrill D. Twine, Army chief of staff and Adm. Adolph A. Burke, chief of naval operations have vigorously denied the allegations in the face of a barrage of questions.

Supporting the plan, Adm. Burke cautioned against following the Joint Chiefs to become involved in too much detail which might lead to "confusion of responsibilities." He added that his branch follows any increase in staff size to be "necessary."

Opposition to the proposal was so indicated in a letter from H. Strom Thurmond, Senator chief counsel for the Defense Department.

"Tearing the plan '390 depicts the opposite of that view, the Attorney General, Commander Chairman Civil War (D-Gen) that 'I cannot believe' that the basic pattern of the Administration's present bill was 'carefully thought through'."

Heard charged that the "major role of the plan lies in the creation of two

parallel chains of command—one for operations and one for support."

He said the President's 1953 plan was based on the idea of the Joint Chiefs writing in a planning body, with the Defense Secretary directing operations through the civilian secretaries of the Army, Navy and Air Force. The plan was leaving almost plant responsibility for command functions, as well as planning, within the Joint Chiefs under the supervision of the Secretary of Defense.

He also mentioned "this change in philosophy" since "both existing approaches" were offered in reference "to the President's broad conception as a military leader."

Two other additions to the bill, added by the White House, also added to the heat of congressional opposition. One clause applied the right of an individual service to an assignment before Congress after notifying the Secretary of Defense.

## West Coast Strike Threat Grows; Labor Aims at Busiest Companies

Los Angeles—Strike action of some sort is now considered likely in the West Coast aviation industry labor disputes but more appear as a selective attack against plants which are sensitive because of heavy business volume and tight schedules, rather than as a walk-out on all important non-negotiating.

International Air of Mechanics and United Auto Workers unions acting jointly have served demand for mediation to the National Mediation Board.

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Effect would be to stiffen industry resistance to labor demands. An industry spokesman said plant representatives have shown local board authority that that intervention of this sort would be "unavoidable."

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interventions. McElroy refused to discuss union plans in detail but said that if strikes are called, "they happen where they have not." In Lockheed Aircraft Corp., it would "last most" in the Muscle Shoals Division, according to John Stacey, president of IAM District 717, Lockheed bargaining unit.

A growing issue in the Lockheed negotiations is the company's request for a separate contract should be written for the Muscle Shoals Division rather than including it in a settlement for the Lockheed Aircraft Division.

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## Unexpected Cosmic Radiation Could Raise Space Flight Problem

Washington—Unexpectedly intense cosmic radiation of unidentified nature which could cause serious problems for manned space flight could extend the reach has been determined at Stanford since 623 m. in data obtained from Explorer I and III satellites.

That at one of preliminary findings recorded last week in the first official report of analysis of data obtained from two U.S. Interplanetary Geophysical Year satellites.

The report was made to members of National Academies of Sciences and American Physical Society.

Unrecorded data reported from Explorer I and III suggest that cosmic ray count of 30-40 per sec. experienced at 200,000 m. altitudes reached 15,000 per sec. at altitudes above 1,000 m. Some tests that have been made to determine whether the radiation results from cosmic ray bombardment from space or from X-rays generated by the satellite itself suggest that the radiation is probably in large part cosmic rays.

If the high count rate results from X-rays, radiation intensity within the satellite is estimated at 0.06 roentgen per hour, causing the maximum allowable human dose per week. This is double that based on prior studies of altitudes beyond 623 m. will require special shielding, greater shielding, or even a possible for tomorrow after some other equipment is available.

The 35,000 counts/sec. figure is based on detection after the usual measurement. Scientists found that cosmic rays and part of the radiation detected at high altitudes without apparent source. Analysis and other space observations have shown that the cosmic rays are produced by the cosmic radiation. Laboratory tests using X-rays indicated that a count of 15,000 per sec. would produce an effect similar to that observed in satellite life.

Intensity of radiation may be sufficient to contribute significantly if not dominantly to heating of the upper atmosphere. Dr. James A. Van Allen, University of Iowa professor and a member of the U.S. Academy of Sciences, said the satellite problem is not yet solved.

He suggested that the nature of new radiation might be determined by an analysis of the amount of atmospheric ionization, light and radio wave produced.

Highlights of reports by other

scientists on satellite findings to date include:

- Explorer I lifetime is now estimated at three to five years.
- Atmospheric density at 230 m. is about two to ten per cent more, or 14 times the figure that had been predicted.
- Microwaves intensity has not been unexpectedly intense. Data indicate that it was one square meter in area will encounter a particle three times or larger in diameter than every 100 sec; a particle 10 microns or larger every 1,000 sec.

## News Digest

**Lockheed Division of Aero Corp.** is developing a helicopter version of its T35 engine designed the T35-43. The 607 hp turboprop version, the T35-43, rated at 1,676 hp. The powerplant will be developing 1,650 hp. Army which is financing both versions though they 50 hp less, is considering using paired turboprop engines to twin a single propeller.

**De Havilland Comet IV** jet airliner last week made its first flight and preliminary tests will begin immediately. First flight included climb to 46,000 ft. speed of 1,300 mph. British Overseas Airways said it is considering putting Comet IV into transatlantic service by late this summer. World Airways has gone that far with its Boeing 707.

**Republic Aviation Corp.** (unrelated) sales totaled \$57,518,275 for the quarter ending March 31, compared with \$56,848,712 for the same period in 1957. Net income after taxes was \$530,023, or 43 cents per share on 1,472,911 common shares outstanding March 31, compared with \$1,776,718 or 31.21 per share on 1,472,911 common shares outstanding at the end of the comparable 1956 period. In a letter to stockholders, Republic reported a 54% income decline in order for USAF P-107 and said an additional 54% income of order for F-101s and parts is contained in the 1958 fiscal period.

**Boeing Aircraft Corp.** last quarter earnings dropped from \$575,771 to a net loss of \$162,437. Sales in the quarter were \$21,748,947 in 1957 to \$18,337,298 for the quarter ending March 31.

## Airlines May Face Military Traffic Loss

Defense officials foresee diversion of traffic if examiner's proposal to drop discount is approved.

By L. L. Doty

Washington—Strong possibility that airlines face a cutback in military traffic revenue next week by a Civil Aeronautics Board examiner's decision upping cutback of the 10% fare discount on military transportation.

Decisions of the board is underscored by the fact that the Defense Department is now the largest source of passenger revenue available to the scheduled airlines.

Last year, scheduled airlines grossed approximately \$64 million from military traffic, or about 85% of the total domestic military passenger fare of \$76 million.

### Defense Stand

However, Defense Department officials contended by Anthony Weiss were "traditionally available" to the airlines that present military programs within the department would force the diversion of more traffic away from the airlines if the existing 10% discount on official military traffic were removed.

They offered an earlier warning by Maj. Gen. George H. Johnson Jr., Army Judge Advocate General, who testified on March 14 before the CAB for the Secretary of the Army that "removal of the agreement [10% discount on military traffic] will unquestionably result in the diversion of an undetermined amount of first-class air travel by the military agencies to other modes of transportation."

In his final decision the Board's hearing examiner, Edward T. Stivala, concluded that the discounted and equalized fare granted to military passengers, resulting in government transportation requests are "arguably discrimination and unlawful." Equalized fare, a special preference granted by the airlines to only official military travelers, provides that if a fare is a discounting rate within 10% of the fare on a direct routing, the military traveler will pay only the direct fare.

Both times have been a source of controversy within the airline industry for the past six months. The dispute first came into the open last fall during an Air Traffic Conference meeting in New Orleans when American Airlines announced its opposition to both the discount and fare equalization. Immediately, seven carriers joined American's stand and equalized the two fare prefer-

ences from their fares charged for military traffic.

However, a threatened loss of traffic to these carriers will offset the discount faced the scheduled airlines to receive their discount within 31 days and to increase the discount and equalized fare practices.

Prior to the recent May Gen. E. C. Lasker, then executive director of the Military Traffic Management Agency, wrote the Air Transport Association that each ferry agency considered it mandatory in the interests of economy to make direct transportation use of the discounting carriers. He added that this would have the effect of "making official travel of less of carriers not posing these accepting the traditional discount."

According to the Civil Aeronautics Board record in the case the discount and equalized fare program of the agreement with the military was approved by American, United and Northeast Airlines. The 10% discount is supported by the Military Traffic Management Agency, Delta, Northwest, Continental and Southern Ohio Western Texas supports both the discount and the equalized fare rates.

Finally, a number of carriers that still support strong of the discount are required to pay a portion of the General Passenger Fare investigation by its special contribution Board, Capital, Eastern, National and TWA offered evidence for the record in the case but have failed to appear to its hearing.

Airline made their first appeals an military traffic beginning in June, 1971.

### Military Market

Washington—Because of the price premium on the military market in fiscal year 1977 over fiscal year 1974, Budget estimates are not available because of differences in reporting methods employed by various military services prior to 1974.

#### PERCENT OF PARTICIPATION

| Fiscal Year | Passenger | Freight | Mail  | Express |
|-------------|-----------|---------|-------|---------|
| 1976        | 41.12     | 14.58   | 11.48 | 32.82   |
| 1977        | 38.87     | 16.16   | 11.48 | 33.49   |
| 1978        | 38.87     | 16.16   | 11.48 | 33.49   |
| 1979        | 38.87     | 16.16   | 11.48 | 33.49   |
| 1980        | 38.87     | 16.16   | 11.48 | 33.49   |

when it is called "preferential discount" in the nation's agreement with the airlines was scored. This discount, which was in effect for 35 years, made it mandatory that the military select only for transportation of personnel with no other limited exceptions.

Airlines supporting the 10% discount maintain that a strong threat to schedule timeliness lies in Section 21 of the Interstate Commerce Act which authorizes free or reduced rates of transportation for persons traveling for the U.S. government. These airlines contend that elimination of the discount will force military agencies to return to rail if only for economic reasons.

### Delta's Brief

In its brief to the board, Delta Air Lines said the "growth in military traffic (by air) has been attributed almost entirely to the granting of the 10% discount and the elimination of the preferential discount in the railroad operations."

In emphasizing how the airlines can afford to absorb the discount without adversely affecting revenues, Delta had this to say:

• **Revenue costs for military traffic are cheaper.** One rail will complete connections for 10 to 12 people traveling on military business, while other traffic must be handled individually.

• **Fueling costs are less for military traffic.** Blocks of tickets can be purchased in advance before rush hours in ticket counters and military passengers can be checked in at airports in groups before their individual flight.

• **Cost of sales is less for military traffic.** Delta said that in October, 1975, a city hotel office and a Joint Military Traffic Office (JAMTO) in one city could process 50,000 of on-line business. Ratio of ticket office costs to sales was 8.25% at the city hotel office and 1.99% at the JAMTO.

• **Average length of haul of military passengers is about twice that of general military passengers.** Domestic civilian passengers average about 545 miles in comparison with the military passengers' average of 965 miles. Delta and a 0.66 percent DC-7 at first-class fares will usually fly about 400 miles with 20 passengers on a trip of 1,000 miles but that the same DC-7 will require 35 passengers to break even on a 900 mile trip.

• **Advertising costs per military passenger are less.**

In its final argument the discount, American Airlines said that it was no

cheaper to transport a military passenger than an air passenger. The carrier, represented by Vice President Walter Johnson, and the "first" majority of military TR (transportation request) passengers do not originate at JAMTO offices and are, therefore, booked at a city hotel office like any other passenger.

Johnson said military passengers are the same amount of advertising expenses as other passengers. He explained that the American advertising program is designed to reach each and every person it can and added, "In purpose it is to inform and to influence and that purpose applies to all potential travelers."

Johnson said the discount was introduced as an "emergency measure" and has shown been "applied on a case-by-case basis." He pointed out that the discount cost American more than \$1 million during the 12 months ending last Sept. 30.

### Air vs. Rail Trend

In discussing any form that the airlines would lose traffic in the months because of the elimination of the discount, American pointed out that schedule frequency of the rail has declined sharply in the past few years as opposed to a marked increase in airline schedules. Using 100 as a 1948 index, the American said that the domestic flight plane index in 1976 was 155 while Class I first-class railroad car index declined to 77 in the same year.

Available seat miles, the American said, emphasized, showed a similar trend. Airline available seat miles jumped from 112.1 billion in 1949 to 23.1 billion in 1976 while railroad available seat miles declined from 21 billion to 14.8 billion in the same period.

In his conclusions, examiner Stivala found the law requires that charges for transportation should be the same to all passengers when the service is the same. He added that military passengers traveling under discounted or equalized fares receive the same transportation and services offered standard fare passengers in the same flight and that the airlines expect and warrant the military fare of that do not apply in civilian travel.

The examiner found that, although the "lack of equality of competitive opportunities between air and rail service" together with "unjustified participation" charges to the military services, and that law has been accomplished and the lack of competition should no longer exist as it exists for airlines which are obviously under the law.

Stivala also concluded that removal to prove the military industry will suffer a loss in military traffic in a result of the elimination of the discount.



IRISH AIR LINES Super Constellation St. Patrick is serviced on landing at Dublin airport. Right hand, right, will have crowd meet the discount.

## Irish Air Lines' Transatlantic Run Ties U.S., Off-line European Cities

By William H. Gentry

Dublin—Irish Air Lines, after five years in 1948 and 1952, began transatlantic service last week, tying in for the first time a long line reported to the ultra-short-haul routes of its entire competition, Air France.

Exposures in the war has long been a primary goal for the transatlantic Irish carriers. Now, Ireland is at the center of its own complex of air in the western region of it.

The Irish hope to give their major airlines with the transatlantic route.

• **Increased tourist traffic from the U.S., benefiting Ireland's economy generally.** Last year 55,000 tourists from America visited Ireland, mostly by air. This figure can be doubled in these few years, the Irish Tourist Board believes.

• **Traffic from the U.S. to feed the Air France short-haul routes in Europe.** Traffic from Europe to feed the long-haul route. The new Irish Air Lines will be to traffic Dublin, a gateway to and from Europe.

As a competitor to the established transatlantic carriers on one-way New York-London or New York-Bombay, Irish Air Lines would find it tough going.

But it has certain advantages in special cases the big airlines now cannot or do not serve.

Locality of Irish-owned U.S. offices in New York, the Irish Tourist Board, maintaining its offices with Irish Air Lines, has opened offices in New York, Chicago and Boston to meet the demand

of these airlines to see the old country again and to visit Ireland to tourist groups. As an indicator of the progress of the campaign, Irish Air Lines had 1,000 bookings in the U.S. as of April 29, and new bookings were being made at a rate of 100 a day since then.

Another area is for tourists who want to visit Ireland first before going on to Great Britain or the Continent.

Still another is transporting Europeans from points of origin of other transatlantic carriers but served by Air France or the U.S. as a U.S. transit point in their ports. Some examples:

• **New York-London.** Irish Air Lines which advertise the most direct service on this journey, expects a sizable traffic this year because of the consistency of service at the Cork and Dublin.

Last year Air France carried only 5,500 scheduled and 1,000 charter passengers there. This year it has 9,000 scheduled bookings from Dublin and expects to carry 10,000 scheduled passengers plus 40,000 charter passengers from Dublin or Britain, with 25,000 bookings already in hand.

• **Birmingham-New York.** This is chosen as a route to New York, as Irish Air Lines began to pick up an unexpected summer passenger at Birmingham who joined the transatlantic Irish flight last week. He was a German who had business in Birmingham and then wanted to go on to New York.

This could be typical of many Air Lines groups, such as Cardiff, Manchester, Düsseldorf, Düsseldorf, New York, Chicago and Boston to meet the demand

## BOMBS AWAY...

with the help of heat-treated  
**TITANIUM ALLOY**

On high speed military planes such as the Douglas A-10 Thunderbolt II and other jet aircraft, the bomb ejector rack is a complicated and critical mechanism. Any failure might endanger both airplane and pilot.

These basic parts make up the ejector cylinder piston and breech. The latter generated the greatest design problem due to its multitude of functions and irregular shape. Breech breeches made from aluminum steel frequently bent twisted and failed, causing test firing or hydrostatic testing.

Experience and design calculations suggested that 6Al-4V titanium alloy, produced by Mallory Sharon, was the metal most likely to meet the exacting requirements.

Actual firing tests confirmed the advantages of titanium for this application.

### WHY TITANIUM WAS CHOSEN

- High strength to weight ratio at elevated temperatures for life times
- Superior corrosion and erosion resistance
- Excellent toughness
- Good machinability to the last finished detail
- Low wearability in hydraulic cylinder seals
- Good thermal conductivity

The titanium alloy breech with about 500 firing holes are an evidence of heat checking appeared. No failures occurred in firing and the breech withstanding hydrostatic pressure of 25,000 psi without failure.

Here's one more example of titanium's outstanding performance in meeting critical design problems. May we help you explore its advantages for your product or application? Write for "Titanium Fact File".

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but having possibilities when assembled. That this Irish Air Lines (Aer Lingus) in Dublin has arranged its transatlantic schedule and Air Lingus is European schedule to give the maximum amount of people experience.

Irish Air Lines has leased three Lockheed 1049H Super Constellation from Seaboard and Western Airlines to provide a daily flight route direct—without a required stop at Shannon.

Dubliners question the value of the Shannon stop, but the importance of the Irish government in the field plus its establishment as a free port to stimulate tourism bring in tourism make it a political necessity.

Seaboard and Western provides the crew, Irish Air Lines the insurance. Initial schedules will be three flights weekly each direction until June 2 when the daily service begins. Estimated, the flight will leave New York at 2:38 p.m. and arrive at Dublin at 7:30 the next morning. The New York flight will leave Dublin at 7:25 a.m. and arrive at 10 p.m.

The flight to Dublin one got an Aer Lingus Vickers Viscount flight the same day.

- London departing at 8:10 a.m. and arriving at 12:30 p.m.
- Rome departing at 2:35 p.m. and arriving at 6:50 p.m.
- Manchester, departing at 9:20 a.m. and arriving at 10:30 a.m.

Not all European ports will be served daily, but similar schedules apply to most Air Lingus cities on its Irish service.

Chief Aeromarine Board member for the Seaboard lease expires May 1, 1966. Irish Air Lines may attempt to name the lease, pending with management from Seaboard, which took a 25% share of the airline at the time of the present for the lease.

However, the carrier plans to set up study committees to consider purchase of turbine transport. Internally, the Irish Air Lines management appears to lean toward turboprops, possibly the Victor VC-10 because of its tail mounted engine configuration and potential use of Rolls-Royce engines, which would give the use of Rolls-Royce.

When at first planned transatlantic service, the carrier had purchased Lockheed 749. An aircraft and a new, company-owned government in 1948 created the program and forced sale of the aircraft. Delay in CAB approval caused a halt in the service when it was moved in 1952 with the airline in power of the Eire de Valera government.

The airline makes it a new coming on stage late in the year, but the importance of the experience a condensed time that the rest, more than a year.

Reuten will be added as a stop later this year, giving added insurance to

one-stop service in each direction. A future possibility is a Chicago stop.

Seaboard is providing 100 seat economy configurations aircraft, but seats will not be held at 93 to 95 in a narrow, to obtain average service. The three Seaboard airplanes are painted white on top with a green stripe and a shamrock, making on the tail, Irish Air Lines has agreed to accept standard service to maintain daily service.

Seaboard led the major overhaul of its New York International Airport base. It also has stage at Shannon. Air Lingus will be the terminal check at Dublin, taking Seaboard for the north. Clearing service began Dublin by the Constellation in under a decade.

Seaboard is considering re-equipping of the Constellation with Allison 351 (F56) turbo-prop engines. This work can be done from the transatlantic flight time and add 3,000 lb payload.

The original flight got an unexpected amount of publicity when a group of reporters, local agents and guests including New York Times, New York, had to make an unscheduled flight to London on the way to Ireland.

No 1 engine showed an abrupt drop in RPM when the engine was crank-

ing at 13,000 ft three hours out of New York. The engine failure confirmed complete loss of power to one cylinder and that the situation was spreading to other cylinders, reducing thrust. The engine was being cranked from the main takes to other cylinder.

The engine was feathered and stress changed to load at London. Just before landing, 1,500 gal of fuel (500 lb) was dumped to bring the airplane down to its 113,000 lb maximum gross weight. GCA approach and landing were normal but No 3 engine feathered as the airplane was cleared after touchdown, further reducing some passengers.

Ground inspection showed a nail in the Curtiss Wright 3150-DAT Turbo Compound engine (AWAP April 27, p. 38). Fuel leaked off the fueler arm No 15 cylinder. The loosened pin and then began to hammer rather than push the valve, the valve stem broke, and the valve was released.

The aircraft was flown back to New York on three engines and Seaboard's overhaul base at New York International Airport changed the No. 1 engine. Then the aircraft was flown back to London to pick up the guests bringing a total delay to about 30 hr.

## Details of Probe Into Collision of United DC-7, F-100 Reported

Washington—First detailed findings on the investigation of the major collision between a United Air Lines DC-7 and an Air Force F-100 at Andrews Air Force Base last week is forthcoming before a House Appropriations Subcommittee.

Elaborating that the Civil Aeronautics Board's investigation of the accident is still under way and uncompleted, Orlin Blake director of the board's Bureau of Safety, brought out these facts before the subcommittee which is looking into the fatal jet-airliner crash and serious injuries.

- Prior to impact, the F-100F was descending at a bank of about 30 deg. It has not been determined whether this was a left bank.
- Flight path of the F-100F was across the nose of the DC-7. Right wing of the F-100F passed through the right wing of the DC-7. Wing of the DC-7 was sheared off at a point beginning approximately 15 ft from the right wing tip and extending rearward at a 45 deg angle to a point 5 ft from the wing tip at the trailing edge.
- Portion of wing approximately 8 ft in length was cut off the F-100F.
- Wing pieces fell from the F-100F.
- Duration of fall of the DC-7 has been computed at about 36 sec from

the moment of impact. Point of collision has been set at a point about 100 ft high or no miles southeast of the Las Vegas Christmas station.

### 'May Day' Call

According to Blake, communications were received from the United DC-7 shortly after the collision. The United aircraft stated the source of the emergency was, under collision over Las Vegas. "May Day".

Blake told the subcommittee that it has not been determined whether communications from the F-100F were received after the collision or prior to the crash.

He said the message received from the Air Force jet began with "May Day" but added that there was some doubt as to whether the words "May Day" were "Mayday" or "May Day".

In his testimony, Blake said that the United pilots reported over Dugway at 11:15 a.m. on May 1, 1966, toward Las Vegas, enroute over the Las Vegas airbase at 5:10 a.m.

At approximately 9:31, the F-100F with an instructor pilot and a student pilot in the rear seat concluded training. The aircraft was then cleared from its operating altitude of 33,000 ft to return to Nellis AFB, Blake said. It



Shown bomb ejector rack showing typical titanium alloy breech (inset). Below: Titanium alloy ejector breech, before and after machining.





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U.S. ARMY

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## SHORTLINES

► Alaska Airlines has placed its first Douglas DC-6A, which the airline bought, converted and is calling a DC-6C in service on the Fairbanks-Sitka-Fairbanks route.  
The aircraft will make round trips from Fairbanks to Anchorage before returning to Sitka.

► Canadian Pacific Airlines is scheduled to begin Bristol-Bermuda 514 service from Vancouver to Amsterdam on June 1. The recently delivered Bristol 16, 16, 31 man, with a bad ship at Coligny, Albert, Canada. Pacific has been authorized by the Canadian Air Transport Board to make a stop at the Azores for passengers and cargo on its scheduled flights from Montreal to Lisbon and Madrid.

► De Havilland Aircraft Co. Ltd. tested the first production model of the Comet IV last week on a flight around London. The company is scheduled to begin delivery of the Comet IV to British Overseas Airways Corp. in September.

► Hawaiian Airlines has completed the sale of 51 million in debentures in the last phase of a financing program to cover the purchase of six new transport aircraft.

► Pan American World Airways has filed with the Civil Aeronautics Board for a one-way fare of \$45 between New York and Puerto Rico. If approved, the new fare would go into effect on May 22.

► Southern Airlines reports a first quarter revenue passenger figure of 16,400, a 4% increase over the same period last year. Revenue passenger miles flown was up 94% over last year in 9,030,000 mi.

► Trans-Canada Airlines is scheduled to begin its Toronto-Montreal-Zurich service on May 17. In June, Swissair is scheduled to start Zurich to Montreal flights the next day.

► United Air Lines reports first quarter 1958 revenues of \$66,143,912, a 10% increase over the same period last year. Operating expenses were \$66,723,376, making a loss of \$579,464. However, \$215,501 gained from the sale of surplus aircraft held the overall loss to \$364,963. Yield revenue passenger miles for the period were 1,754,950,000, a 5% increase over the last quarter of 1957.

## AIRLINE OBSERVER

► Wards for a new route for Japan Air Lines from Tokyo to Los Angeles is adding to the present Tokyo-San Francisco route to compete in the closed outcome of present talks in Tokyo on amendments to the U.S.-Japan bilateral agreement. In exchange for the route, restrictions on the frequency of flight schedules of U.S. carriers into Tokyo probably will be eased. Present thinking from toward an unrestricted number of flights without great Japanese government approval, which is now required, with a provision that schedule frequency must be cut back after a period of time if traffic does not justify the schedule.

► Northwest Airlines is transferring two Douglas DC-6Bs from its New York-Miami run to New England routes to handle summer traffic in the southern sector of the airline's system.

► Republic delivered additional two-engine B-4s and single-engine An-2s will enable the Bulgarian airline TARGO to increase traffic "intermittently" in 1958, according to K. Kerlev, Bulgaria's end in station chief. Republic and the current surplus of passengers and cargo loads in 1957 and related net losses could be over 12%. Republic's airline TARGO expects an 18 1/2% increase in passenger carried last year and hopes to expand its international routes in 1958 through negotiations with Greece and Egypt.

► American Airlines' target date for the first scheduled jet transcontinental passenger service is Nov. 1.

► New York Airways has made an agreement with Varig covering the trade-in of the carrier's fleet of Sikorsky S-55s and S-56s for two Varig twin-engine 44-Bs. New York Airways was to make of present fleet and related assets will bring between \$1.1 million and \$1.2 million, "depending on the state of the art book value" of the assets.

► Pan American World Airways is opening its door for a re-opening of the Transpacific Route Case. Latest efforts by the carrier for reconsideration brought the case back into the White House but there it has been stalled, at least temporarily, by lack of Presidential action.

► Civil Aeronautics Board has denied a request by California Air Charter, a supplemental air carrier, to conduct scheduled flights over scheduled Western Air Lines' route between Salt Lake City and Los Angeles for the duration of the strike. The Board found that alternative means of transportation are available to passengers who would otherwise use Western's services and that California Air Charter failed to back its petition by showing that a critical or necessary transportation situation exists.

► All Transport Area has petitioned the Civil Aeronautics Board for authority to be authorized to operate scheduled flights between Portland, Oregon and Seattle. The Board has denied the petition. Pending action would include only those involved in the particular discussion under discussion such as fare, plus, student fares, children fares and open jaw rates. ATA is seeking national standards in decision phase to eliminate inconsistency to passengers, unexplained ticketing procedures and unnecessary costs.

► Chicago O'Hare Airport has received authority to expand its scheduled passenger service to include Washington, D.C. and Gary, Ind. Present passenger service is confined to the triangle route from O'Hare Field, Midway Airport and the Chicago Loop.

► Civil Aeronautics Administration's scheduled direct toward preferential of air traffic as a key step in the reduction of the mid-air collision threat is still being studied by lack of long-range radar facilities (AW April 28, p. 40). Last week, House Appropriations Committee voted to authorize for fiscal year 1959 from a requested \$30 million for 20 aircraft to \$15 million for 10 planes with instruction to make better use of existing radar facilities. Military services have been cooperative in establishing ground-use of radar but the procedure is not always satisfactory for civil purposes.



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On short-sector, high-frequency flights the new Local Service Viscount will provide the lowest operating costs of any passenger aircraft in this category. Design refinements

make possible exceptionally low break-even load factors on local service operations. Vickers engineers will gladly make a complete cost analysis of your routes.

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Since its introduction to American service in 1955, the Viscount has firmly established itself as the most preferred of all modern airliners. Because of its rapid climb, descent, and speed, the prop-jet Viscount has boosted load

factors on average of 55% for 32 airlines worldwide. The new Local Service Viscount will comfortably accommodate 30 or 45 passengers. Its relaxed configuration offers ample space for passenger luggage and mail.

### Dependable, economical Rolls-Royce power

The Local Service Viscount is powered by low performance-per-hour Rolls-Royce Dart 506 jet-prop. These engines have demonstrated their outstanding performance and reliability under operating conditions similar to those of local service operations. The Dart 506 engines are recom-

passed for economy, ease of maintenance and hours between overhauls. (F.C.A. reports approval for 1800 hours—worth recent jet engine hour runs to 2000 hours.) They give the Viscount exceptional take-off and climb performance and a cruising speed of 300 mph at 10,000 feet.

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The Local Service Viscount can be serviced on routes of up to five 100-mile sectors—without refueling and with a minimum of ground handling. Procedures are made for fast refueling by pressure refueling at terminal points (refueling facilities are also provided). Low ground equipment is needed and valuable time is saved by the Viscount's integral, hydraulically operated stairs. Further savings are gained by the cabin ready

rapid water-methanol jet (intermediate stops).

The 45 engine can be kept running during intermediate stop-overs—thus saving ample power for restarting the engines. If longer stop-overs are required, integral refueling is still possible because of increased fuselage capacity. Seats on number 1, 3 and 5 engine prevent encroaching of cargo, permit quick, quick on-and-off loading of passengers on the left side, freight on the right.

### Local Service Viscount means Jet Age growth for you and the communities you service!

By saving flying time almost in half—and by introducing Jet Age service comparable to the best offered by the "turbine" line—the Viscount will open doors in important new business traffic that service overland routes. This growth will benefit not only local centers, but the areas they serve—areas that deserve the opportunities that come with the best and most modern airline service.

Because the Local Service Viscount is tailored for highly economical operations—and because its payload capacity is sufficient to absorb future growth—it is the ideal airliner for local service routes today and tomorrow.

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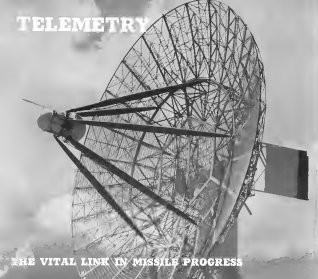
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# SPACE TECHNOLOGY



FIVE subjects occupied space cabin simulators at Wright Air Development Center for 120 hr during a space flight experiment.

## USAF Simulates Space Crew Conditions

By Everett Clark

Dryden-Project Longshot—a series of simulated space missions flown by five men sealed in a capsule—is covering scenarios that human factors will play an increasingly dominant role in the design of future USAF weapon systems.

Wright, a prime consideration in designing systems for atmospheric flight, will be even more important in space vehicles. Men must not only take bar environment with them into space, he must get it there against the ever-increasing resistance of the atmosphere.

Reliability, less critical in atmospheric systems because escape is possible, will become far more critical in space flight.

Range will increase in distance for flight within the atmosphere and even for traditional vehicles such as intercontinental ballistic missiles, is being examined more and more in a new dimension by the planners of space flight—that of time.

Because time is becoming so vital a part of the weapon system design equa-



PHOTOGRAPHIC equipment monitors volunteers in WADC space cabin simulator. Equipment is used to record volunteers' physiological, psychological and psychiatric behavior.





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ted to the risks that will be involved in space travel. Now, however, the basic question of space survival, much less the question of efficient operation of a complex machine.

To put the necessary human USAF researchers must attempt to simulate as much space flight conditions as possible. Psychological, physiological and sociological reactions to motion, heat, cold and radiation, buffeting and vibration at 20,000 ft., and other aspects of actual and long-range space flight have been explored in some degree, but not in effect for Research and Development Command. Crews have been sent to all these conditions still in proper order.

Project Longshot aims at studying in great detail some of the most critical and least known factors—the physical, psychological, physiological and sociological reactions and interactions of five men exposed to long-term confinement.

All scenarios are flown in a specially designed mockup of a crew compartment about 100 cubic feet for confinement studies in the 308135A module number program.

### Outgrowth of Studies

The current series of experiments is an outgrowth of confinement studies during back in 1957, when men were in the ground cockpit of an F-84 for 76 hr.

First scenario, five-day mission was flown in May of 1957. Named "Long Con," it was a dry run designed primarily to teach the researchers what the problems of confining the experiment would be. Next run was made last August with a different crew.

The most recent run, called Starlight 2, took place last March 13 to March 19 with still another crew.

In 120 hr. duration was with a few hours short of the 137 hr. necessary to encompass the most on one job period.

Next mission will be somewhat longer—possibly 15 days, simulating the 500 hr. run along a more probable mission-consumption rate.

All experiments are set up in actual simulators with specific tests and specific work cycles assigned to each run. Starlight 2 called for manual and long-range at Wright-Patterson AFB and some other around the earth, and repeated the same to repeat as they passed over Midwest states.

Critical portion in the mission was from 180 to 104 hr., when the peak effort for the vehicle to change orbit for a photo reconnaissance run over Tokyo in a mission called Airfield Dodge.

On the way of the five-day flight on carried past at the beginning of the critical period when water in the air

**Aircraft Assembly Engineers prove it!**



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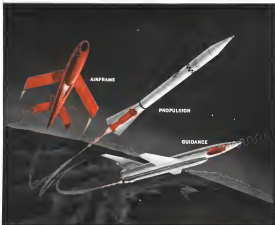
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Ryan Aeronautical Company, San Diego, Calif.

the toilet caught fire. Members of the 34-49 were support teams outside the compacted goods substituted a revised toilet and performance of the mission went unimpeded although some crew members reported later that they had smelled smoke.

Like the accident-proof vehicle. Design of the electric toilet is type used on the B-51, has been modified to prevent a recurrence.

Compartment incorporates a number of unusual design features. It is 17 in. by 14 in. by 18 7/8 in. and is divided into a work area, made up of five crew stations, a food bar and a lower area containing a pull-out bunk.

Structural concept of integrated structural panels and reinforced rings, rigid walls for use of an emergency oxygen in the atmosphere. Both compartment and capsules are designed so that no portable, bridge or pressure suit is necessary, and capsules include 1,100 in. of space for global survival gear.

Capsules are designed for maximum return, and maximum comfort. Polyethylene foam seats have proved to be comfortable that some crewmen spend 90% of their 16 hr. on-duty time sitting down. Padded capsule headrests incorporate two fixed, five output speakers. Crewman's head is at the head part of the speaker and he selects one of three channels of tape-recorded music to relieve boredom, then, while in a no-draft. Radar and antennas over rule the music at all stations.

On the first and second five-day missions, personnel came from the "standard" channels such as oldies, rock, pop, etc.—all those equivalent of morning and the "relaxation" channels—soft music, dance music, etc.—all evening. "Combination" channels got less use. But on the third mission, we preference pattern emerged.

Design of the compartment complex with psychological devices in a dual-level concept of keeping all segment of working life to give an impression of continuity, a barrier and stark white floor in the recreation area to give the feeling of a step down to leisure, different color schemes in the two main areas to separate "house" from "office," and deep, 120 lb. soldiers. Some reports have suggested that some prices are needed in the sleeping area.

In line with the philosophy that pleasant surroundings will reduce stress and keep officers brighter, each man is afforded considerable freedom in his choice of high-contrast, low bulk from meals and snacks.

Eating becomes extremely important. Activity logs kept on crew members each man makes time point to point show that considerable time both on and off duty is spent in the dining area. They particularly like at the food



In one pressure instrument, CEC's 6-201 Primary Pressure Standard offers an extended range of precise pressure measurements available in no other similar equipment. Operating as a pressure standard, the 6-201 offers the advantages of air rather than oil as the pressure medium, extreme accuracy of 0.015% of full range even at pressures of less than one psi, cleanliness and portability regardless of the pressure range. Increases the flexible range to absolute-type instruments capable only on mass and length measurements for its accuracy. It is a true primary pressure standard. It will calibrate any pressure-measuring device. Simple combinations of pressure/weights and weights provide full pressure ranges within the limits of 0.3 to 500 psi, each with increments of 10, for both gauge and absolute measurements. For additional information, call your nearest CEC sales and service office, or write for Bulletin CEC 1501-S12.



Transducer Division

**Consolidated ElectroDynamics**



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## HOW ONE CONCEPT IN POTENTIOMETER DESIGN SOLVES THREE BASIC PROBLEMS

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You can pack a lot of Bourns potentiometers into a small space—12 in one square inch of panel area (or 17 Tilt-A-POT JR. units). Fit them into corners, between other components, flat against chassis or printed circuit boards. Mount them individually or in stacked assemblies.



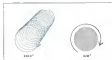
### ADJUSTMENT STABILITY

Bourns potentiometers are self-locking (no lock nuts required). Any adjustment remains stable. Shock, vibration or acceleration can't affect a setting. Bourns potentiometers are helping thousands of engineers make reliability a reality.



### CIRCUIT BALANCING ACCURACY

Bourns potentiometers are 33 times as accurate as conventional single-turn rotary types—the screw adjusted mechanism provides 9999% of rotation instead of only 270°. Circuit balancing, calibration—adjustments of all types are easier, faster, more precise. And repeatability is assured.



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DESIGNERS OF STABILITY AND PRECISION  
POTENTIOMETER TECHNOLOGY FOR PRECISION AND ACCURACY

ber" one of the planners of the experiment said. "It's not too food bar, but it's not too food bar, but it's not too food bar."

Romanus and Jordan and the several members of thought that concern you to food because they know this about people at themselves, observe those in far distance.

On the masses left August, weight gain for the five men ranged from 8 to 10 to 15 lb., and researchers began to wonder what might happen on a season of exercise in space.

On the most recent run, however, weight gains were insignificant, in some measurements were called for.

"We found that the other five we had a food observed leader," one pilot, said. "He was a big eater and he talked food and food food all the time. It was the power of suggestion. On the next flight, all personnel just loaded."

Nevertheless recognize that crew will have to be selected carefully, because of the effects of such on the others. Furthermore, training in exercise and development of techniques to minimize group conflicts may be necessary.

### Day-Night Cycles

Adjustment to new day-night cycles proved to be a problem for some crewmen at first. Although this solved itself on the short flight, there is still considerable question about such large flights since man's physiology was adjusted to and regulated by the physical phenomena of the earth's orbiting.

No two men were on the same day-night cycles. The aircraft commander, copilot and flight engineer worked 16 hr and rested eight, but these shifts were staggered. The navigator and defense director worked a 12-on, 12-off routine.

There was almost a refreshed man coming on duty to work as a rest of outfit. Crewmen slept an average of more than 70% while off duty.

Although the subjects are preselected is the sense that their work RSM pilots with considerable work capacity, there has been little special screening for the day-night mission.

There has been, however, extensive testing beforehand to give a baseline for evaluating backward, physiological, psychological, psychiatric and neurological changes. Extensive testing also is done immediately following a mission.

Five days of briefing and three of practice, using an operating manual, precede each mission, partly to accustom the physiological adjustments that the men are to make. Each man also spends 21 hr in individual isolation.

During the mission, crewmen were

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Condiesel has provided more aircraft and missile ground support in a variety and variety than any other manufacturing organization. Specialized support equipment is the division's specialization.

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  - Hydraulic
  - Pneumatic
- Missile Support
  - Testing
  - Fueling
  - Blending
  - Launching



**POWER  
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Stamford, Connecticut

Over 15,000 Condiesel power generating units serve every branch of the armed forces. Manufactured in every type and size, these units provide precise electric power wherever required. Typical: T-10, T-12, T-14, T-16, T-18, T-20, T-22, T-24, T-26, T-28, T-30, T-32, T-34, T-36, T-38, T-40, T-42, T-44, T-46, T-48, T-50, T-52, T-54, T-56, T-58, T-60, T-62, T-64, T-66, T-68, T-70, T-72, T-74, T-76, T-78, T-80, T-82, T-84, T-86, T-88, T-90, T-92, T-94, T-96, T-98, T-100.

Products include:

- Uninterrupted Power Supply Units
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- Diesel and Gasoline Engine Generator Sets
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Test equipment for the manufacture and support of missiles and aircraft. Condiesel designed and built equipment is used by Hamilton Standard, Allison, Holly, TMA, the American ... and in support of Materiel, Republic, Lear Corp.

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At Can Avionics, advanced electronic capabilities produce a broad range of electronic systems. Typical is the automatic digital computer check out equipment for the aircraft guidance computer of the "F-15" ECM.

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- Automatic test and control systems
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Products include:

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- Transducers ... actuators
- Temperature sensing devices
- Nuclear control systems



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mounted in the cockpit, and the pilot's voice, tape, recording and electronic, in steadily steady sound their response to situations indicated on their instrument panel.

RAA tracking scores and other measures of performance show excellent results. On the August mission, per flight track, from scores for all four men were above average. Post flight scores indicated B or C performance for four men, but the fifth was scored below average. In last five months of flight, the cockpit crew of three who had little sleep in the last day and a half—tracked 95% on the glide path under simulated GCA simulated land up conditions.

In one month of each hour of flight, the cockpit crew and pilot have done outstanding work. They have taken on each man in terms of single, high-altitude, low-altitude, which was played in it, and others. Also each man kept a diary, and in his own words he had developed into each day into which he reported fatigue he might not reveal otherwise.

Data reduction and correlation in a lengthy process. The Straight 2 mission was not flown until a good percentage of the information from last August's flight had been studied.

No technical reports on the Long shot flights have been returned to far and researchers are anxious about off-put conclusions.

Although night vision, a true sense of danger and other factors cannot be simulated in these flights, researchers here feel the Longshot flights are yielding extremely valuable information as the effect of confidence and time on personal responses and group dynamics.

## Curtiss-Wright Gets AEC Reactor Permit

Washington—Atomic Energy Commission has announced it proposes to issue a license to Curtiss-Wright Corp. for operation of a gas-type research reactor at Greenvale, Pa. A construction permit was issued in May, 1957. Reactor is to be used for experimental programs covering shielding studies, neutron component and material development, investigation of radiation damage, neutron physics and isotope production.

Facility, occupying a plot of land of 1,060 sq. ft., is housed in company's Rodman's Materials Laboratory on a 51,600-sq-ft tract near Greenvale. License will be for 30 yr.

In another action, the AEC said it also proposes to issue a permit to General Dynamics Corp., San Diego, Calif., for construction of a research reactor at Torrey Pines Mesa, San Diego.

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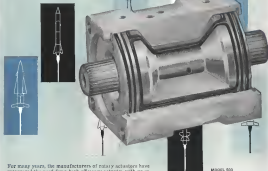




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Now, at Turbocraft, a method of continuous O-ring sealing has been devised and has been tested with unprecedented results. TORK-SEL, a rotary actuator offering low static and dynamic friction, has a proven efficiency rating of approximately 90%, along with remountable refraction of backlash.

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GIMBALS • VALVES • CANARDS AND OTHER MISSILE AND AIRCRAFT APPLICATIONS



### Soviets Claim Record Launch

Russian claimed a record height of 294 mi. (473 km.) after launching of single-stage rocket from left last Feb. 21. Rocket was launched from European section of USSR and carried geophysical scientific instruments, radio-telemetry devices and fuel. Engines used 3,144 lb. rocket followed post-placed flight. Kerosene equipment was used in some. Rocket at right reached 192 mi. (312 km.) and carried equipment on left side.

triple spot in missile's trajectory.

- Weather conditions over full range which affect photography, optical tracking.
- Weather effects on communications, electromagnetic tracking equipment and systems.

Final phases of countdown start after the missile is "loaded," when propellants and explosives used to destroy targets in case of malfunction, or in such sequence, are placed aboard and the missile becomes "hot" or armed.

At this point, wires to the missile are removed, that is, the guides are rolled back, baldest and other control equipment is taken away and all operations become remote. Emergency provisions must be made for "helping" alignment, since missile stands in hazardous conditions.

Although fuel is sometimes loaded with gases still in place, liquid oxygen is never placed aboard the missile until the area is completely cleared. Safety is a top consideration at all points in missile operations, and Cosmo has never had a major accident in its operations, back to the days of the research vehicle MX-774.



While there is a set of three variables in loading the missile, when liquid oxygen is placed aboard, the missile is within 1 hr. of launch. After access to the missile is removed all operations still can be performed manually from the launchers, both in preflight loading and tank topping, pressurization and depressurization, and defueling.

### Tension Mounts

It is here, after the missile is loaded, that the tension mounts.

Unless we learn on one, not left on. Confirmation is obtained from range equipment as to three observations of certain conditions about the missile, such as instrumentation wiring, which range monitors are able to check in such kind. Cosmo's Test Conductor (TC), the boss for the contract crew and Madeline operators, control contact with his countdown until authorization has been obtained and range element acknowledged from the proper range personnel.

Nonfatal can stop a countdown if their indications do not show a certain piece of control instrumentation in proper working order, since this is de-

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TITANIUM?  
STAINLESS?  
ALUMINUM?**



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converts these vector signals into a position corresponding to the defined space vector.

By thus reproducing the conditions of an actual high-performance aircraft in flight, the unit reproduces the capabilities of any laboratory.

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velocity/altitude flight test, the goal is data. Once all firing shots in the Super-tanker of Range Operations (SRO). He monitors the maps, while the TC maintains the visual staff. The two merge their activity and efforts to ensure successful data gathering during the flight.

### Firing Team

Two additional key personnel in a firing are the Plot Safety Officer in the blackhouse, who observes progress of the missile toward the launch, and the Range Safety Officer in the Control Center with the SRO, who prevents the disastrous failure of missile warheads or cruise.

During that part of the launch countdown, either the SRO or TC can adjust (stop and restart) the countdown if problems arise, working with each other. Final clearance to fly the bird is given by the SRO, and must be given before automatic sequence starts.

Automatic sequence period varies from 60 to 30 sec prior to zero time, performs the instrument operations automatically, but with manual override from blackhouse control center in case of malfunction.

Zero time is a highly variable point. Its variations can include:

- Time ignition of rocket engines take place.
- Time propellant inertia goes into main stage, or full gradient flow and thrust buildup to maximum.
- Time of actual launch itself.

Presumably, zero time is a reference point rather than a signal for new particular element in a missile launch to occur. Elements which come into play at launch are the radio frequency link, command, telemetry equipment, the destruct system. Developed by Canam, the Avion system now serves for range tracking, but it has capabilities for becoming a guidance system.

An automatic sequencing of missile events starts, stage instrumentation is at its first point and it also enters auto sequencing stage. But, certain elements are automatically activated, ranging from launch currents to adjust rate sets to downrange radar sets. This can be needed in case of a malfunction or adjustment of the countdown which causes the automatic sequence to occur in order of the manual override control equipment.

## Vanguard Designers Detail Second Stage

Avion, Cold-Segment stage Vanguard rocket engine is fabricated from 3250 weldable aluminum alloy tubing, utilizes a square cross section and uses external wrapping to absorb loads. Aerojet-General Corp., fabricates and de-

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and fine wire types.



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on spark the jet, tur-  
bo-prop, rocket and  
modules of today...  
and the future!



**FINAL ASSEMBLY** where the modules assembly is  
checked in the shell. Working with a continuous check of the  
module, the finished aircraft spark plug begins its final  
check. After the shell components are in place they are  
checked under heat and pressure to form a permanent seal. The  
final seal is made in a 1000 psi test.



**FINAL INSPECTION** of the finished aircraft spark  
plug includes a final inspection, continuous test, high voltage  
leak test and final X-ray. After checking the plug for  
defects, the plug is ready for its final test.



**PACKAGING AND LABELING** a final step in  
making the AC Aircraft Spark Plug. The plug is placed in a  
box of packaging material to ensure the safety of  
the plug. The plug is then ready for its final test.

system of the propellant system,  
decided last year.

Use of tube yields natural channel-  
structure for segmental, cooled chan-  
nel while wetting allows chamber  
pressure as high as 700 to 1,000 psi,  
although the Vanguard chamber pres-  
sure is less than 500 psi.

Hypersonic propellants, concentrated  
ductile resistance for fast and in-  
habited white facing nitric acid for  
cooler, no pressure hot, with helium  
as pressurizing agent, and are expected  
at a number ratio of 2.8.

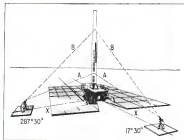
Although flame temperature is in  
the range of 5,000°F, the high conduc-  
tivity of aluminum alloy and flow of  
the subcooled white facing nitric  
acid coolant, which is the cooling  
fluid, combine to heat throat cham-  
ber wall temperature to 4500°F at maxi-  
mum.

Throat diameter is gaseous, yields  
7,700 ft thrust at ultimate, has a burn-  
ing time of 138 sec. Dry weight of the  
propellant system is 550 lb. Maximum  
Minimum specific impulse is a range  
at 271 lb/sec. Maximum thrust is  
able to total weight ratio is 2.8 sec.  
Propellant system is designed to carry  
second and third stages from 50 mi. to  
500 mi. distance from earth surface.

Tubing for the chamber is of var-  
ious size due to variations in shape for  
the nozzle, wall thickness is below  
0.01.

Tubes are shaped to the throat cham-  
ber, nozzle throat and nozzle proper  
configuration as specially made form  
gates, then welded together for the  
assembly.

Nozzle expansion ratio is 20:1, and  
exhaust velocity for the engine at alti-  
tude is from 8,000 to 9,000 fpi.



**VANGUARD** must be vertical at time of launching. Diagram shows how engineers check  
vehicle's position against hypotenuse reference line formed by intersection of two optically  
projected, right-angle planes.

## Optical Tooling Devices Check Missile for Correct Alignment

In launching of large missiles, mis-  
alignment can result in trajectory devi-  
ations and excessive fuel consumption,  
which may cause an expensive piece of  
hardware to miss its target.

Problem of alignment is basically the  
same for all large missiles, whether they  
carry a warhead or a satellite, and it  
takes little difference whether this is  
aligned to true vertical or to some spe-  
cific angle less than 90 deg.

What actually creates a problem is  
the high degree of precision required—  
precision beyond that attainable with

conventional mechanical or surveying  
tools alone. To achieve desired accu-  
racy, missile crews use optical align-  
ment devices, some of which have been  
developed specifically for this work while  
others were adapted from units already in  
use on the production line.

For the Vanguard, the cross in align-  
ment of the pressure sensitive calculated  
center bar running through the ve-  
hicle—must not exceed two minutes of  
arc deviation from true vertical. To  
place the vehicle within these limits,  
optical tooling devices supplied by Keel-

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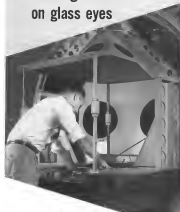
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at OReon 5-2222

## Grafting metal skin on glass eyes



That's Bausch & Lomb technology in vacuum-coating a lens 2mm thick with thin films of metallic salts to increase control of light and color. If the lens were enlarged to the height of Mt. Washington (6,288'), the lens coating would be equivalent to a few inch-thick transparent layer. Two submicroscopic surface-fining methods, developed by B&L, make possible anomalies in selective reflectance and transmittance of light of very specific wavelengths. Practical applications range from color TV to directional control of guided missiles. How does this kind of advance technology fit in with your current plans?

Write for complimentary copy of LIMITED EDITION, "OPTICAL COMMITTEE" (on official letterhead, please, indicating title). Bausch & Lomb Optical Co., 5809 St. Paul Street, Rochester 2, New York.

BAUSCH & LOMB



fit & function are made as follows:

Two thrusts, supplied with apertured intermediate-vapors of increasing diameter as set on two lens X and Y (collimated by conventional surveying prisms) which converge at a right angle 1 mm each stream the line of sight of the thrust is able to describe, in optical plane which is vertical (space travel is carefully leveled so its own speed platform is made sure that the optical planes are truly vertical). The intersection of these two planes form a hypothetical vertical line at the center of the rocket.

Two light (lens A and B on the ground) are made from each station against continuous target placed on the outside of the vehicle, top and bottom with reference to the calculated center line. The placement of the target takes place while the Vanguard is still in the Martin Co. plant in Baltimore, Md.

When the upper target viewing is associated in the instrument, reference to the lower target reading makes specified tolerance, i.e., when the displacement of each target is the same from the optical center plane, the vehicle is vertical within one plane. When the target readings from the second target similarly confirm the vehicle is vertical in a second plane. And once the two planes are at right angles, the rocket is then truly vertical. Adjustments in either plane are made as needed with leveling jacks which are under the launching pad.

### Vanguard Alignment

In the case of Vanguard, there are other problems presented by alignment of the third stage. When third stage is attached at the launch pad, its thrust axis must be aligned to the previous one within six minutes of use. But the third stage is too short to use the same truth tapes as before. (i.e., external markers would be spaced too close to define the coordinate accurately.)

To solve this problem, Kodak A. Ezer developed an optical instrument called an auto-collimating plumb aligner, which is essentially a fixed focus telescope held vertically in a special support. Technique for using it is as follows:

Front surface mirror is affixed to a flat pad mounted on top of the third stage engine so that the mirror surface is square to the thrust axis. The amount of tilt of the mirror corresponding to the deviation of the third stage thrust axis from the previous axis.

To measure the amount and direction of the tilt the collimator is moved on the gurney to a position above the third stage. The cross-hairs of the instrument are aligned parallel to the previous, uncorrected ground line with the aid of one of the blue thrust and two other

## Intercept research at Westinghouse



Gift to U.S. Navy photograph

## Air-to-air intercept far at sea...

For today's defense by fleet aircraft and tomorrow's by space ship or missile carrier, positive interception systems are being designed and built at Westinghouse Air Arm.

With over 30 years experience in airborne electronics, including the highly efficient Aero 13 and related systems, Westinghouse is developing advanced concepts and systems in:

Recognition  
Navigation  
Communication

Guidance & Interception  
Armament  
Flight Control

For information on these advanced developments, call or write the Westinghouse Air Arm Division, P.O. Box 744, Baltimore 3, Md.

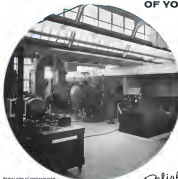
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targets attached to the collimator. This gives the collimator its gyroscopic properties. A level bubble cut mounted exactly to the barrel of the astronaut gives it its critical position.

Light bulbs is placed in the eyepiece so that it shines down the barrel through the eyepiece and onto the target. It is locked to the third stage. The beam, of course, is reflected. Direction of the reflected beam depends on tilt of the mirror. Idea is to bring the reflected beam in line with the model beam by tilting the third stage with its attached mirror.

The direction in which the third stage mirror must be tilted can be determined by reference to the cross-hair which already has been lined up gyroscopically. When the selected image of the cross-hair is superimposed (auto-collimated) on the actual cross-hair, the third stage float sits in properly aligned with the primary aim and the Vanguard is correctly aimed for launch.

## Navy Contracts

Following is a list of selected contracts for \$25,000 and over as released by Navy Contracting Office, **WASHINGTON, D. C.**  
**William Fisher Products, Inc.** (Chicago) production of ten 27.5 in. dia. round air-able floats (including three with master float) under a 10 year firm Army-Navy order. **NAVAL AIRCRAFT DEVELOPMENT CENTER, WRIGHT-PATTERSON AIR FORCE BASE, OHIO** (NAD-47-01-000-001) \$25,000.

**Radio-Power Division, Seattle, Wash.** (SEA-47-01-000-001) \$25,000. Production of ten 27.5 in. dia. round air-able floats (including three with master float) under a 10 year firm Army-Navy order. **NAVAL AIRCRAFT DEVELOPMENT CENTER, WRIGHT-PATTERSON AIR FORCE BASE, OHIO** (NAD-47-01-000-001) \$25,000.

**Scientific Res. Service, N. Y.** (NAD-47-01-000-001) \$25,000. Production of ten 27.5 in. dia. round air-able floats (including three with master float) under a 10 year firm Army-Navy order. **NAVAL AIRCRAFT DEVELOPMENT CENTER, WRIGHT-PATTERSON AIR FORCE BASE, OHIO** (NAD-47-01-000-001) \$25,000.

**Allenbrook Manufacturing Co. of Austin, Tex.** (AUS-47-01-000-001) \$25,000. Production of ten 27.5 in. dia. round air-able floats (including three with master float) under a 10 year firm Army-Navy order. **NAVAL AIRCRAFT DEVELOPMENT CENTER, WRIGHT-PATTERSON AIR FORCE BASE, OHIO** (NAD-47-01-000-001) \$25,000.

**Combinatorics Corporation, Evanston, Ill.** (EVA-47-01-000-001) \$25,000. Production of ten 27.5 in. dia. round air-able floats (including three with master float) under a 10 year firm Army-Navy order. **NAVAL AIRCRAFT DEVELOPMENT CENTER, WRIGHT-PATTERSON AIR FORCE BASE, OHIO** (NAD-47-01-000-001) \$25,000.

**General Electric, General Dynamics Corp., Fort Worth, Tex.** (FTW-47-01-000-001) \$25,000. Production of ten 27.5 in. dia. round air-able floats (including three with master float) under a 10 year firm Army-Navy order. **NAVAL AIRCRAFT DEVELOPMENT CENTER, WRIGHT-PATTERSON AIR FORCE BASE, OHIO** (NAD-47-01-000-001) \$25,000.

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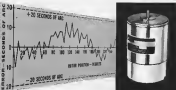
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## NEW ULTRA-PRECISE SIZE 26 SYNCHROS

Kearfott's proven data transmission is possible through the use of Kearfott's Size 26 synchro receivers. The inherent precision of these units provides a three sigma accuracy of approximately 30 seconds in a unit setting without the use of auxiliary equipment. Mapped constructed of corrosion resistant materials, they possess the required reliability for all marine applications. Available in transmitter, differential and control transformer with a maximum error from E & Z of 20 seconds arc.



## SIZE 11 SYNCHROS

Size 11-3 phase 4 wire synchro receivers for data transmission combine the advantages of data transmission with high accuracy. Corrosion resistant materials are used in the construction of these units. Available in RX transmitters, differentials and control transformers with a maximum error from electrical error of 3 minutes arc. Standard 3 wire transmitters are available from production with a 7 and 15 minute maximum error from E & Z.

## SALES

Challenging opportunities for sales representatives in all major markets



**KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.**  
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Marine Division: 10 W. Riverside Ave., Los Angeles, Calif.  
North Central Division: 5111 Denton Drive, Dallas, Texas  
West Coast Office: 154 N. Wilshire Avenue, Pasadena, California

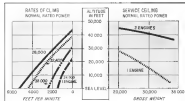


LOCKHEED CL-329 JetStar ground velocity runs 40 ft. ahead of nose. Tread is 30 ft. 9 in., wheel base is 20 ft. 9 in.

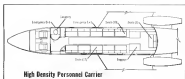
#### Aviation Week Pilot Report

## JetStar Appears to Meet USAF Needs

By Robert J. Stauffer



PERFORMANCE above based on T377 turbojets. Configuration below carries 22 passengers



Months. Gas-Performance and characteristics at varied speed regimes and altitudes indicate that Lockheed's first all-weather JetStar CL-329 is well on to USAF's urgent need of a flexible jet replacement for its current crop of obsolete World War II piston-engine utility aircraft.

JetStar, currently powered by two Bristol Siddeley 175 turbojets (AVC, Sept. 10, 1957, p. 108), demonstrated its adaptability for training, transport, low-level attack, heavy freight, and high-speed reconnaissance, and operating as an electronic or advanced bomber. In addition to its qualities as a high-speed 10-passenger VTOL jet, it supports its low-level work at 4,000 ft. of cargo.

Flight evaluation by Avionics West, pointed up these key features of the 60,000-lb. CL-329:

- Acceleration and climb: Anytime re-climb from idle to maximum—first 10 to 10,000 ft.—in about five sec. Prototype was flown out of the ground in less than 3,000 ft. at about 120 kt. Acceleration to initial climb speed of 150 kt. was rapid, coming over the net of the 38,000 ft. runway, out and climb speed was 235 kt. It was held to initial rate of climb of 4,000 ftm. because of low cloud deck. Max. climb at sea level is 6,400 ftm.
- Slow flight and landing: CL-329 has

## AERONAUTICAL ENGINEERING



STANDARD passenger seats with 10 with 40-in. spacing (left). Flight controls are dual (right), engine controls are standard.

fly gently at all speeds. Pattern speeds are as a pair with minor manual repositioning engine speed. We flew downwind at 150 kt., base at 130 kt., level at 115, touchdown at 98. Landing distance approximated 1,000 ft. Wind was quartering at 10 kt.

• **Jet power:** Engine pods are mounted high and aft on fuselage. Current turbojets are prototype Carver-Wright and flow type T377 rated at 4,550 lb. sea level thrust at takeoff, 4,150 lb. thrust for maximum continuous operation. Dry weight of engine is 906 lb. Thrust/weight ratio is 4.9 to 1. Gross pressure ratio is 4.4 to 1. Air flow is 31 ft. 6 in. per sec. Prototype JetStar has been flown single-engine from 115 kt. on takeoff, accelerated to 1,800 ftm. to 7,000 ft., climbed single-engine from 15,000 to 23,000 ft. at 600 ftm.

• **Speed and altitude:** Gas is sufficient to maintain CL-329 as evident. We reached 15,000 ft. in about 10 min., reaching true speed something for hold in low-level climb mode. At normal power we found out at about 175 mph. Airplane has flown at altitude of 45,000 ft. at speeds in excess of 600 mph. Air conditioned and pressurized, JetStar was comfortable and quiet. Cabin pressure altitude of 5,000 ft. is maintained at 45,000 ft. altitude. Cabin pressure differential is 8.7 psi.

#### Fuel and Range

Fuel is stored in wing integral tanks, plus wing tank of about 140 gal. in rear end of wing tank. Capacities of each wing, including wing, is 830 gal. for normal tank at 1,640 gal. or 11,660 lb. Fuel is kerosene type—JP-4.

Range will be increased to 300 gal. upper tank or 140 gal. lower tank on each wing. Normal range of the JetStar is 1,500 mi. base at 130 kt. With two glove tanks this would be increased to 2,200 mi. on. Range is based on 79 kt. base/land plan 30 min. endurance at sea level in line of MA 501 A.

Anytime will be offered in both twin and four-engine configurations, embracing either the two Carver-Wright T377As (Bristol Siddeley built under license, or first of the estimated 1,500 ft. short-range Fenchel 18s or General Electric 18s when they become available. Indications are that T377A

### JetStar CL-329 Dimensions

|                                   |              |
|-----------------------------------|--------------|
| Wing area (sq. ft.)               | 221          |
| Aspect ratio                      | 5.5          |
| Taper ratio                       | 0.811        |
| Thickness                         | 0.22/0.09    |
| Sweep (deg.)                      | 30 deg.      |
| Span                              | 55 ft. 6 in. |
| Length                            | 39 ft. 6 in. |
| Height                            | 20 ft. 6 in. |
| Horizontal tail area (sq. ft.)    | 149          |
| Horizontal tail span              | 24 ft. 9 in. |
| Vertical tail area (sq. ft.)      | 284          |
| Vertical tail span (ft.)          | 140          |
| Total wetted area (sq. ft.)       | 2,607        |
| Fuselage chamber outside          | 38 ft.       |
| Fuselage inside to center         | 34 ft.       |
| Cabin length                      | 60 ft.       |
| Cabin height                      | 15 ft. 7 in. |
| Wing spacing                      | 40 ft.       |
| Wing/engines                      | 2/18         |
| Max. density seating              | 22           |
| Max. cabin capacity/altitude      | 12/7         |
| Max. cargo (lb.)                  | 4,800        |
| Normal fuel, internal wing (gal.) | 1,640        |
| • Intermediate fuel (gal.)        | 2,210        |
| • Minimum fuel (gal.)             | 2,300        |
| • 140 gal. upper tank per wing    |              |
| • 140 gal. lower tank per wing    |              |





Swift light indicator when radar is key tone exceeds production level. Other checks can be obtained with frequency indicator and relative power meter.

## New portable radar tester makes fast "go, no-go" check

Tests all radars aboard aircraft, requires no training to operate

Here's the fastest means yet developed for testing aircraft radar on the flightline or in the field. It's the new Sperry Microline® Radar Performance Tester and anyone can use it—no special training is required.

Weighing only 24 pounds (30 for C-band), this tester is self-powered (batteries) and is easily carried about. It prevents costly delays by providing a quick, over-all check of all aircraft

radars in only minutes.

This is the only performance tester that checks the alignment between transmitter and receiver positively and accurately by flipping a single switch. Interchangeable plug-in echo box covers permit checking either C or X-band radars. Transmitters and circuits with built-in testing features compensate for light weight and reliable performance.

If you'd like to know more about this

new Sperry Microline Radar Performance Tester, write our Microwave Electronics Division.

MICROWAVE ELECTRONICS DIVISION

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Lockheed JetStar prototype is about to touch down. Flaps are fully extended type. Drag chute can be used if necessary.

perform the fourjet configuration with 55 turboturbo.

Lockheed also holds reserve delivery positions for about 58 commercial firms pending USAF order.

Lockheed specs show top speed of the four engine configuration to be 611 mph for normal missions, 593 mph for extended range. Optimum cruise speed with four engines would be 510 mph for normal missions, 454 mph for extended range. Stall speed, best condition, at max landing weight of 28,000 lb., is 105 mph.

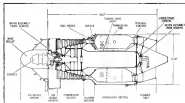
### Engine Availability

Production J137 engines, 130 hp, type certified will be available in April 1959. Production on initial period is forecast to be 500 for 1959 and 1960. Two JetStar prototypes have been flown at about 250 hp with J137 engines per American West spec, but that prototype engines have a definite more, run-up low, than on level rated. 4,950 to show that on JetStar flight was over delay because of engine trouble.

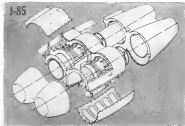
Engine on this was neither new prototype, N1324K, which was made had been flown about 25 hr. Number one prototype, N1324, with total time of about 230 hr., had been flown about 50 hr. in USAF during Phase II testing at Edwards AFB, Calif.

Long range airplane—25 ft. 10 in. long with wing span of 53 ft. 8 in.—low and drag to ground. Height over tail is 28 ft. 6 in. Wheel track is 10 ft. 9 in., wheel base is 24 ft. 6 in. Nose houses antenna and electronic equipment. Because of low nose JetStar cannot mount AN/APN-59 radar. Lockheed will propose use of smaller commercial equipment.

Hydraulic and air conditioning sys-



CUSTOMER WEIGHT J137 turboprop engine (above) has a 49 to 1 thrust ratio. Drawing below shows how two General Electric J85s would be installed on a four-engine JetStar.



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United States Steel Supply Company, New York

most, baggy space is located just forward of wingtip, as accessible through open bulkhead door. Cabin length of 28 ft allows flexibility of interior arrangement.

Walk-around inspection shows cleanliness of design. Wings are single bulk 24 deg from fuselage. Engines aft of wing can be easily serviced and maintained. Access to wing-spool access, engine and fuel compartments is provided by split housing. Half bulk is quickly removable for inspection of spool or engine portions of compartment.

We entered aircraft through cabin door located aft of pilots compartment and forward of engine, on left side. Door swings inward and aft to open. Control handles are made and actuated, and door is secured by flow lockers in place. Detachable handle fits flush on door when locked. To lock and unlock, handles are rotated 90 deg.

Cabin is lower type and narrow. With 6 ft 5 in head clearance, we didn't have to duck. As plane was started, 100-percent current configuration. Cabin baggage compartment, 27 ft 16 in, from door. Main baggage space is provided aft of cabin in space entered via left open bulkhead door. Bins are out to located adjacent to right-hand number three passenger seat which opens over leading edge of right wing. To the rear is nosecone of 25 ft 39 in, galley of 29 ft 39 in, and lavatory, 17 ft 79 in.

## Comfortable Cockpit

Cockpit is compact and comfortable. One man drive can fit, as plane is about as strong. Pilot's seat, adjust in height, lean, and aft movement and tilt at lockout. Flight controls are dual control wheel and sidestick pushback adjustment for left or right control column. Flight instruments are mounted on both panels and engine gauges. Engine instruments are contained. Engine controls, sidestick pushback switch, fuel compartment, sidestick controls, VIF, ADF, are located on control pedestal between pilots.



SPED hole is close to ground, correct for need during testing, takeoff, or landing.

Overhead panel, electric control, electric fuel control, and engine instruments and switches, starting switches, fuel indicator and light switches. Panel lights, engine regulator and tachometer for each pilot are mounted adjacent to seats.

Each engine contains condenser struts within an intake duct buffet. As foreseen at pressure of 100 psi, engine single stage turbine which is two vertical engine through section of planetary gear, clutch and engaging mechanism.

Starting procedure for jet engine

slightly simple. Number three is electric pump on (Shelby provides pressure for operation of fuel boost pump). Start sequence is left engine ignition turned on. Start is achieved, throttle to idle. Engine start switch on. Same procedure is followed for right engine.

Left engine fired up quickly and spool was advanced to 5400 to engine self-vent bleed air for operation of left air turbine motor. With left ATM on, generator was cut in and battery switched on. Two air turbine motors are contained in baggage compartment, attached to speed brake for operation of two hydraulic pumps and two d.c. gen.

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## OVERWING REFUELING

No. 9400 high capacity mobile refueling pump, remote, self-cleaning, aluminum truck, electric refueling system. Also No. 9400 Man-Del oil carts for delivery of fuel oil. Features main shut-off, non-drip valves in and out of tube.



## UNDERWING REFUELING

No. 4000 valve is easily connected to aircraft fueling system. Features a positive lockout/stop mechanism. Also mechanism designed to deliver 600 gpm at pressure drop of 1 PSI through valve and adapter. Several different models available.



## HYDRANT SYSTEMS

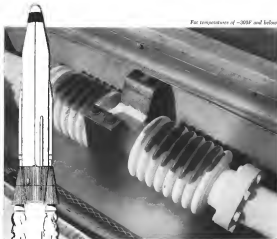
No. 12000 Emergency Shut-off valve can be remotely actuated. Adapter permits valve and emergency shut-off valve work independently of each other. Also No. 4000 series standard hydrant adapters, No. 4000 series hydrant coupling valves.



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## Sola-Flex® joints provide safe, easy handling of liquid missile fuels

**LIQUID OXYGEN**, used in Cosma's Atlas ICBM, requires the very best handling know-how and equipment. These rugged Sola-Flex expansion joints are in use at Cosma's full test facility at San Diego, California. Made from 321 stainless, the 8 in. double-end seal-bellows unit handles over 5 in. of axial movement in a 100° test line.

Sola manufactures the most comprehensive line of bellows and expansion joints in the world. They are made from a wide variety of stainless and high alloys for important nuclear, missile and industrial applications—in sizes ranging from 1/4 in.

to 35 in. in diameter. They are built for service from -300F to 1500F. And they have "hard-to-handle" pressures up to 3000 psi for special applications.

A new pamphlet describes Sola's complete line of expansion joints. Write for it to Dept. F-16, Solar Aircraft Company, San Diego 15, California.



**No other missile test lab can do all the things we can do**

Take our 100-foot test tower. With it we can simulate the pressure and aerodynamic loadings that occur during the actual launching and flight of a missile.

This is just one of the many specialized facilities and tools that we have built up in the last ten years. During this decade—because of our complete responsibility for the development of a major weapon system—we have also piled up a wealth of experience in many related fields.

The upshot of this is that we can handle any project from far-out basic research to static and dynamic testing of complete airframes.

For example, we can simulate aerodynamic loading test loading at the same time...on a complete wing, or a large section of fuselage. We've old hands at applying heat gradients from leading to trailing edges and sparswise. And we are equipped to compute temperature differentials, and to predict specific area temperatures.

We're completely qualified to work with any kind of matrix or nonmatrix, elastomers and processes, electrical, hydraulic and pneumatic components and systems, structures, reliability, environmental testing (including re-entry), and astronautation.

Now we'd like to solve your problems. The tougher the better.

Please write to E. R. Schaeffer, Missile Development Test Lab Manager, North American Aviation, 32214 Lakewood Blvd., Downey, Calif.

**MISSILE DEVELOPMENT DIVISION**

North American Aviation, Inc.





The almost instantaneous return to normal of the new low-voltage Cat power unit under conditions of full-load application, and load rejection (137.4 volts), is shown in the above graph.



Low-voltage Cat power unit with close voltage regulation is now being used in connection with ground support for jet starting and firing. The 400-cycle phase is specifically adapted to auxiliary.

## Caterpillar power fires SNARK...first U. S. intercontinental missile

The U. S. Air Force **SNARK** SM-62, the first U. S. intercontinental guided missile, is fired with power from an electric set, developed by Caterpillar and now being supplied to the military.

The full designation of this specialized power unit is Caterpillar 60 KW 400-cycle 120-200 voltages low-voltage portable ground support unit with precision voltage regulation.

The secret of this unit is the almost instantaneous recovery to both applied and rejected loads.

Other advantages found in all Caterpillar Engines include: trouble-free operation over a wide range of loads; dependability and long life; economy of operation; maintenance and operation by unskilled personnel; world-wide parts and service; and the ability to operate on any fuel from JP-4 through No. 2 furnace oil.

Consistent engineering and quality of manufacture

have made Caterpillar the diesel leader for more than 25 years. For detailed information on the Cat 60 KW 400-cycle portable power unit with close voltage regulation, send in the coupon below.

Engine Division, Caterpillar Tractor Co., Peoria, Ill., U. S. A.

Circle 10 on Reader Service Card

**BY CATERPILLAR**

Dept. A-15, Engine Division  
Special Interest Material  
CATERPILLAR TRACTOR CO., Peoria, Illinois, U. S. A.  
Please send me additional detailed information on Caterpillar Electric Sets.

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City \_\_\_\_\_ State \_\_\_\_\_

crashes. Right engine was held to idle. Self-contained starting system always used for APU, with timing of revs.

Taxiing was smooth and all-around windshield space made for good visibility. We moved at a fair clip with that high rpm on left engine. Jet turbine motor for hydraulic and electrical systems will be mounted on production models. Systems will be run off direct-drive type pumps on each engine.

### Nose Wheel Steering

Nose wheel deflection for steering, via wheel on pilot's side, is 90 deg. in each direction. Brakes can be used where necessary.

There were 12 of us aboard, including Lew Sullivan, chief engineering test pilot of Lockheed's Martin B-57s, and Bob Schumacher, sport pilot project test pilot who has been with the jetliner since its inception.

With full complement, plus some 6,800 lb. of fuel, airplane ground out at 24,135 lb. Center of gravity was 29% MAC.

Wind at altitude was from 30 deg. at 10 kt. Sea level pressure was 29.77 in. Outside air temperature was 67F.

We took off in the east, no flap, with throttles to 10,000 rpm. Acceleration—boom—into full power—about 5 sec. Airplane moved full down runway and at about 50 kt. radiator became effective. Nose was raised at about 95 kt. and jetliner was airborne at 128 kt.—before we hit the third quarter on the 10,000 ft. runway.

With 49% flaps, 43-470 rpm cut off at 10 kt. slower speed, we lost runway. Full flap, two 100%—retracted flaps 50 deg.

### Climb Speed

\* Airplane climbed swiftly, initially at 160 kt. and 10,000 rpm. Maximum specified speed until gas extracts at 700 kt. At 5,000 ft. we bled into test climb speed of 275 kt. 145, reducing rpm to 9,500. Speed and rpm were held constant on up to 55,000 ft. (Max continuous power is 9,500 rpm or 5,500 exhaust gas temperature.)

Visibility was excellent during climb. However, we had to reduce rate of climb—holding to 4,000 ft.—because of cloud deck at 5,500 ft. About 15 mi. out we found a hole and went up.

At 9,000 ft. rate of climb was 4,500 ftm. Exhaust gas temperature was 610C; fuel flow 1,820 lb. per hr. Rate fire quickness of airplane was evident during climb. Natural convection was possible between pilots and passengers. Lockheed plans further development for production model.

Jetliner handled out nicely during ascent, for hand-off light. Elevator and sidestick control are suggested by de-



## FAST and FUNCTIONAL

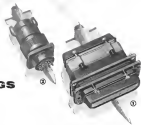
The crisp, sleek lines of Northrop's T-38 supersonic jet trainer reflect a new concept in design...offering light weight and simplicity to achieve high performance...yet keeping the price tag low and minimizing maintenance costs.

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Please refer to Dep. 118



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London, Melbourne, Paris, Tokyo, Buenos Aires,  
and distribution in all other cities. Please see  
your distributor before buying.

gles, boosters. Pilot supplies only one-  
eighth of total fuel, required for altitude  
control, one-third of force required for  
climb control. Rudder pedal forces  
are reduced by means of the servo ac-  
tion of trim tabs.

Altitude climbed through 25,000 ft.  
at 1,500 fpm, from 50 to 55,000 at  
1,200 fpm.

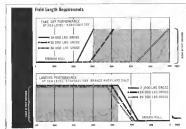
At altitude, pulling 85% power jet-  
star indicated 270 lb. Altitude was not  
checked with fuel air temperature gauge.  
Estimated outside air temperature to be  
about -40C, we figured one 1/8 to  
be 450 lb. or 55% right.

Control at 35,000 ft. was good. We  
had no trouble outside of our own  
roughness holding altitude during  
time at various degrees of bank and  
angled jetstar in transient laterally  
by much as center pedestal, which  
electronically actuates tab on left aileron.

Radio emergency notes fast, and  
off for longitudes time. Vertical in a  
huged at lower alt. corner and it re-  
lated to, d.c. motor-driven double screw  
jack. Total travel is 9 deg. of stab  
free angle. Two switches located on  
each side of pedestal, for pilot and co-  
pilot control tabs.

In case of emergency, disconnect  
switch is positioned on each control  
stick so that either pilot may sever all  
power connections to trim actuators.

During flight, airplane remained



quite comfortable. Cabin pressure, at  
altitude held to 8,000 ft. Passenger oxy-  
gen system will automatically pressure  
up should cabin altitude reach 10,000 ft.  
Should depressurization occur, usual  
compartment door on each wing  
under seat pops open, revealing  
pluggable mask. System also can be  
triggered by pilot.

If cabin altitude exceeds 10,000 ft.,  
which will happen at 45,000 ft. if

pressure runs below approximately 5,000  
psi—warning light will alert pilot.

Altitude is presently limited to 425  
lb. 1/8 for extension of speed brake  
located under and aft on landing, just  
forward of emergency. Brake will come  
as baggage compartment door on per-  
forbidden models, in prototype, as access  
to air turbine motor, hydraulic and air  
conditioning systems.

Speed brake contains small hinged

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# BOMARC



Official U. S. Air Force Photo

## It tracks down an enemy at 300 miles

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up, then, powered by two ramjet engines, it hurtles by electronic instant to its target at up to 3 times the speed of sound. For this guardian of our homes and way of life, RCA has been privileged to supply important advance components of the guidance system.



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CAMDEN, NEW JERSEY

down within its main structure to its drop buffer. Fall travel is about 60 deg. We dropped back at altitude and left accurate determination of zero, with only slight settling distance.

With back extended, and fuelflow to idle, descent can be made from 45,000 to 10,000 ft in about four minutes—at rate of 8,100 fpm.

We dropped down to 21,000 ft at rate of 4,000 fpm. At that altitude we cut back power and stalled jetflow to close configuration. Entry was made with nose up, full centered. Flight was slightly heavy due to excess of fuel over left, necessitating silicon control during entry.

Still warning-continuous transmission signal through headset and head speaker—received about 120 kt. TAS. Still was preceded by steady buffet for five back. Airplane broke at 100 kt. There was no sharp drop. With normal recovery procedure, altitude loss was about 200 ft. Airplane can be "rolled" out of stall.

Astute wing loading data over entry rate in wing tips, and in parabolic showed stall speed and no period characteristics of slow speeds.

We stalled airplane a second time with boost off. While increased pilot force was used, excessive strength is not required to fly airplane. Still results were about the same.

### Single Engine

With turbojets mounted on rear fuselage, single-engine performance presents no critical problem. Rapid turn is not necessary. We set the single engine and needed but two degrees of throttle to maintain directional control, slight elevator trim as speed dropped to 775 kt.

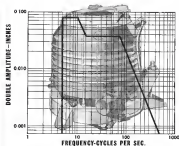
Turning away from and into dead engine flight characteristics were normal. Speechman state that best single engine speed, gear up, is 555 kt. per second, 145 kt.

An extra six single and made with throttle closed, emergency fuel shutoff valve open, confirmed us. Rate of 1,180/1,500 should be maintained at speed of about 355 kt. Turning rate too to start, however, no advanced light-off occurring before throttle reached idle. After rpm stabilized, engine was turned off.

No engine fire extinguisher action is installed in jetflow. Guarded switches on main instrument panel, which operate valves located in wing fillet, permit emergency fuel shutoff in event of engine fire.

Two-hour fire extinguishing system consisting of two 2.5 lb. CF-808 bottles at 400 psi are provided for speed brake compartment. Switch is on engine's instrument panel.

Automatic refueling is provided by bleed air. Jetflow pilot boost air wing



## NEW "RUGGEDIZED" BENDIX OXYGEN CONVERTERS

meets MIL-E-5272, Procedure I, vibration requirements

The superior design and shock-resistant features of Bendix' new liquid oxygen converters was proved recently in severe vibration tests conducted at Pioneer-Central Division, premier producer of airborne liquid oxygen systems. These advanced-type 16-liter units met and exceeded MIL-E-5272, Procedure I maximum and cycling vibration tests at room temperature as specified in MIL-E-5272, Section 4.7.1.

Moreover, these compact converters weigh less than 75 per cent of the weight allowed by Military Specifications and require less space than their 8-liter predecessors.

Other design features include: An economy design that permits low pressure operation with maximum use of available gas, with little or no

seal, a capillary sensing probe that not only constantly scans the liquid level inside the converter regardless of pressure, but by being removable greatly facilitates replacement and converter decontamination.

Bendix Liquid Oxygen Converters are available in a variety of configurations—including an inverted mounting design. They are easily adaptable to virtually any type high-performance aircraft. No matter what your oxygen breathing requirements may be—either airborne or otherwise—Bendix is prepared to serve you. PIONEER-CENTRAL DIVISION, BENDIX AVIATION CORPORATION, BENTONVILLE, MISSA.

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- Both Durying and Intergrating types available with postamplifier for poor repeatability
- Complete size range: 8, 10, 11, 15, 18. Can be designed with gear train
  - $-54^{\circ}\text{C}$  to  $+135^{\circ}\text{C}$  ambient temperature range
- Designed to MIL-8272.
- Assembled under closely controlled environmental conditions.



400 CPM SERVO MOTOR - TACHOMETER GENERATOR

| Index Type        | Size | Search Ratio | WLS | Ratio<br>WLS/LS | Round Messages |       | Time to<br>Send<br>LS (sec) | Ratio<br>WLS/LS<br>(sec) | Total<br>Time<br>(sec) | Sensitivity (%) |             |                              |                              |
|-------------------|------|--------------|-----|-----------------|----------------|-------|-----------------------------|--------------------------|------------------------|-----------------|-------------|------------------------------|------------------------------|
|                   |      |              |     |                 | 25 K           | 50 K  |                             |                          |                        | Base<br>Rate    | WLS<br>Rate | WLS<br>Rate<br>/Base<br>Rate | WLS<br>Rate<br>/Base<br>Rate |
|                   |      |              |     |                 | 10000          | 10000 |                             |                          |                        |                 |             |                              |                              |
| 100000-100000-10  | 1    | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-20  | 2    | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-30  | 3    | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-40  | 4    | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-50  | 5    | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-60  | 6    | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-70  | 7    | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-80  | 8    | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-90  | 9    | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-100 | 10   | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-110 | 11   | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-120 | 12   | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-130 | 13   | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-140 | 14   | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-150 | 15   | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-160 | 16   | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-170 | 17   | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-180 | 18   | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-190 | 19   | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |
| 100000-100000-200 | 20   | 0.0000       | 0.0 | 0.0             | 0              | 0     | 0.0000                      | 0.0                      | 0.00                   | 100             | 100         | 1.00                         | 1.00                         |

These cells derived by HT-1080 but were characterized as HT-1080-derived in a previous paper. The cells were grown in 12-well plates.

Other products include action, architecture, railway, motor-car, trains, AC drivemotors, DC motors, screw mechanisms as well as, reference and Scherbius press steel, screw torque units, schroter and motor drive blowers and the assemblies.

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Interested, varied work on designing transistor circuits and servo mechanisms. Contact Mr. Robert Burns, Personnel Manager, in confidence.

polyester and Co. Windshield is heated by hot air.

Four or leading speed berths was dropped and initial approach made at 180 kt. Berth was raised and gear and half flaps dropped. Present drag buoys cannot be used in landing, too in time off because of ground clearance problems. Extended, it's only about five in four general, would be an one-half approach. USAI reported, would pay for buoys forward, combine it with course buoys.

Airplane flew downward at 150 kt. Turning base, open at 6,000, we dropped full flaps, selected speed to 130 kt. Flaps are full upon started top-down section on each wing. Activation is hydraulic. JetStar was turned on first at 120 kt, you still at 6,000. We were over the tower at 115 kt, with gradual descent. Touchdown was at 90 kt.

In event of go-around, thrusting would be advanced to 10,000 rpm, slow-reversing flaps and gear retracted and climb-out initiated at 180 kt. Climb pattern, at 6,000 rpm, can be flown on less than 200 gal. of fuel.

Group Chat

CL-128 ground roll can be reduced to a minimum of 490 ft, with resultant brake saving, by use of drag chute. Self-deployable 16-ft. chute is installed in fuselage tail cone. Minimum speed for release is 130 kt. Chute is located on right side of pilot's instrument panel. Chute can be left in deployed position for test with both engines operating.

Cost of the jetStar will approximate \$1 million. Production would begin on July 1 at Lockheed's Marietta Division if an Air Force order is received in time. First shipment of the utility jet would be 17 months later, in November, 1999. Production would accelerate to 30 a month about two years after the initial go-ahead date (AWW Mar. 31, p. 18).

Using a modified Air Transport Association method of computation, based on 500-hr-year utilization, Lockheed argues that the JetStar, using T757 engines, would cost \$1.03 a statute mile, 12.5¢ per seat-mile. Total operating cost per statute mile, Aviation Week was told, would be \$496.

Other exclusions: Maintenance based on 750 hr overhead cycle, \$55.37 per hr. Fuel-IP4 type at 14.50 gal—\$51.30 per hr. Oil, \$3.75 per hr. An additional crew salaries computed are \$16,000 for pilot, \$4,000 for copilot. Expenses for the taxi, at \$2.90 per hr, would total \$1,500. Insurance cost is not at \$83.71 per hr.

Commercial market over the next 18 years would embrace about 700 assets, Lockheed representatives estimated.

### JetStar Normal Mission

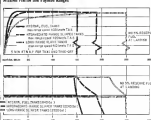
|  | ORIGINAL  | CURTIS-ELECTRIC 180 | WILSON T200A1 |
|--|-----------|---------------------|---------------|
| Yakow Stress (lb)                      | 20,877 Lb | 20,157 Lb           |               |
| Permanence                             | 10        | 10                  |               |
| Feed (in)                              | 10.014 Lb | 10.014 Lb           |               |
| Keeps†                                 | 1,330 H/L | 1,500 H/L           |               |
| Area, Crater (ft)                      | 46,400 Ft | 42,000 Ft           |               |
| Service Galling (TGSW)                 | 47,130 Ft | 44,000 Ft           |               |
| Service Galling, 1 Day                 | 45,634 Ft | 33,000 Ft           |               |
| Gutter Mark                            | 77        | 70                  |               |
| Oil (Cubic Foot Length)                | 2,010 Ft  | 3,000 Ft            |               |
| Leaking Speed (ML Spm)                 | 44 K/L    | 40 K/L              |               |
| Oil, Yakow's Feed Length               | 3,700 Ft  | 3,000 Ft            |               |
| Oil, Leaking Feed Length (in, 1000 Lb) | 4,030 Ft  | 3,000 Ft            |               |
| Leaking Speed Feed (1/2 Ft)            | 4,710 Ft  | 4,000 Ft            |               |
| With 30 Ft. Feeding Gulls              | 1,200 Ft  | 1,200 Ft            |               |
| Leaking Water (1/2 Ft)                 | 5,040 Ft  | 3,000 Ft            |               |
| With 30 Ft. Feeding Gulls              | 2,700 Ft  | 2,700 Ft            |               |

### Extended Range Mission

|                                       | GENERAL       | CERTIFIED     |
|---------------------------------------|---------------|---------------|
|                                       | WARRANTY (YR) | WARRANTY (YR) |
| Torque-Wrench Wt.                     | 16,872 Lbs.   | 20,287 Lbs.   |
| Fuel Wt.                              | 17,314 Lbs.   |               |
| Bumps <sup>1</sup>                    | 2 360 H.M.    | 2 300 H.M.    |
| Max. Crank Aft.                       | 45,000 Ft.    | 45,000 Ft.    |
| Service Ceiling (RPM)                 | 40,000 Ft.    | 30,000 Ft.    |
| Service Ceiling: 3 Eng.               | 50,000 Ft.    |               |
| MTU: Output Field Length              | 4,770 Ft.     | 6,000 Ft.     |
|                                       |               | [40%] Thrust  |
|                                       |               | Amplification |
| Leading Speed                         | 41 Kt         | 47 Kt         |
| C&K Leading Field Length              | 7,350 Ft.     | 9,100 Ft.     |
| C&K Leading Field Length (31,000 Lb.) | 3,220 Ft.     | 3,170 Ft.     |
| Leading Speed (31,000 Lb.)            | 1,400 Ft.     |               |
| With 30 Ft. Drag Chute                | 1,470 Ft.     | 1,450 Ft.     |
| Leading Distance (31,000 Lb.)         | 5,940 Ft.     | 5,120 Ft.     |
| With 30 Ft. Drag Chute                | 5,940 Ft.     | 5,000 Ft.     |

<sup>a</sup> www.fda.gov. Downloaded from fda.fda.gov on 04/10/2014

### Measure Profile and Potential Biases



Today's air power in action:\*



Somewhere over California a Douglas C-124A heads East toward assignment to our 150TH Air Transport Wing (Heavy) based at Dover, Delaware.

*"It more than pays for itself! The turbo-prop C-124A operates at a much lower cost per ton-mile and with far less flight and maintenance personnel per ton-mile than any other air freighter now in service. It is estimated that it will more than pay for itself in reduced operating costs alone in less than 7 years."*

## This Air Force giant can swallow an ICBM

The new Douglas C-124A is the only jet age airplane capable of transporting both IIRBM and ICBM missile systems. It dwarfs all other U.S. cargo aircraft in productivity, capacity and range, yet operates at the lowest cost in air transport history.

This huge turbo-prop air freighter can airlift 100,000 lbs. of payload more than 1,100 miles; it can transport 42,000 lbs. more than 4,000 miles non-stop. Its cargo ton-mile costs are as low as 1¢ on both short and long haul

operations. It has the fastest loading and unloading time per ton of any modern airplane. Yet, despite its huge size and 280 mph speed, it can operate from short runways.

Because of its ability to move the giant new missiles and their supporting equipment anywhere in the world in hours, the C-124A makes it possible to achieve a major increase in the effectiveness of our overseas bases while decreasing their size. It will buy more protection per dollar for the American taxpayer.

Continuous cargo hold of the Douglas C-124A is capable of transporting the Air Force production IIRBM T102E and all other current IIRBM and ICBM missiles and their supporting equipment to U.S. bases throughout the world in a matter of hours.



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**DOUGLAS**  
*The most respected name  
in Aviation*



now, with basic modules build...

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#### DIGITAL OHMMETERS



#### DIGITAL RATIONMETERS



### Or a COMPLETE DIGITAL, MISSILE ELECTRICAL CHECKOUT SYSTEM

for measuring DC to 0.02%, AC to 0.2%, Ohms to 0.01%, DC ratios to 0.01% and AC ratios to 0.02%

**Standard, off-the-shelf modules make systems adaptable—provide maximum versatility.** As such changes, simply reprogram old modules or add new ones. Your system is always current at minimum cost and engineering. Internal construction is also modularized for ease of maintenance.

**Fully automated circuits result in increased reliability, reduced power consumption, low heat dissipation, miniaturized packages, and eliminate radio noise and line transients.**

**Instantaneous measurements—**Wider, dynamic ranges cover all voltages down 190 microseconds to 3,000 volts, resistance from 50 milliohms to 10 megohms. Input power frequencies from 50 to 400 cycles. True balance logic speeds down ranging. Automatic AC ranging from 50 to 10,000 cycles. Use of transistors increases switch life by a factor of three.

**Wide selection of input and output modules for operating panels, IBM punches, etc., can be accommodated without modification.** All systems are accessible at rear panels with convenience. With plug-in modules, diagnosed faults are provided as printed form, detailed checks or tape without modification to basic measuring instruments.



This Short Zero-Gravity check complete contribution to both load and testing modules. Test for 0.01%.

**ELECTRO INSTRUMENTS**

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**ENTRE** JetStar emergency return line and air fuel longitudinal lines. Total travel is more than 100 ft. JetStar is mated to a transport vehicle.

control. JetStar carries 10 forward during return shots on 40 in. tubing. As a high density personnel carrier it carries 22 people on two long rows of 11 side-by-side seats. Utility cargo van can provide space of 750 cu ft. Fuel load capacity of 4,000 lb is achieved with oil fuel density of 6.7 lb per cu ft.

In addition to factors previously noted, there are other advantages to mounting modules on the rear line legs.

- Engine noise sensors and timing pairs are located aft of cabin.
- Air intake are protected by the wing from foreign object ingestion.
- Airframe structure is separated from exhaust noise, avoiding buffeting, vibrations and fatigue.
- Engine fire hazards are isolated from cabin to fire detection system. When uncontrolled fire can occur in pod fuel pod should fall line of airplane.
- Hot engine exhaust makes for more comfortable cabin, speed pattern on front of engine exhaust.
- Passenger and ground personnel are separated from intake to jet blast danger.
- During belly landing engine would not be subject to direct impact.

JetStar's fuel system incorporates low pressure filter, two powered engine driven fuel pumps, and a combined fuel control unit. Fuel is delivered by boost pump via low pressure filter to engine driven pumps which discharge it at high pressure to conventional chamber burners via combined control unit. Flow to burners is subject to automatic correction for engine rpm, barometric

air temp, tip fueling stage. JetStar fuel control system is located above fuel, but line to prevent dumping below approx 250 ft.

Dump rate is about 35 to 40 gpm from each tank. Section has passive satisfaction in arrangement up to 150 lb. post and flap actuated.

Airplane start air system is located in aft baggage compartment and consists of two 15 in. spherical pressure vessels containing 10.75 ft. air at 2,000 psi. Two safety relief valves set to open at 1,800 psi are located on high pressure manifold. Two air pressure regulators mounted on sensor reduce high pressure air to 200 psi for delivery to engine start.

Ground start cart has start room powers as airplane's start system except that pressure containers control of four "Aqua 1" cylinders containing 24.6 lb air each at 2,000 psi. One such lifting five cart assemblies is mounted on JetStar at speed brake opening right side.

In event of compressor failure or low pressure or better and no start available, it is 15 min and 4 in. fitting on left side of speed brake opening are used for connecting external oxygen cylinders.

Electrical system is 28v, d.c., single wire center that is grounded through aircraft structure. Alternating current is supplied by two rotary inverter units geared from a.c. system. Direct current is supplied by two AFM devices. 510 amp generator paralleled with two 15 amp batteries connected in series for 24v operation.

Normal inverter supplies 3 phase, 400 cycle, 115v power and is rated at 1,500 amp. Emergency inverter (250v, 500 amp) supplies 3 phase, 400 cycle, 115v power in essential bus only for



### B-58s Receive Between-Flight Maintenance

Five Convair B-58 Hustler bombers receive between-flight maintenance in experimental hangar at Ft. Worth, Tex., which accommodates B-58s but could hold only two Convair B-36 heavy bombers. Length of the B-58 is 97 ft, length of the B-36 is about 152 ft.

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### Retadyne Flies With Complete Tail

British F4U Corsair makes first flight of the transport as made without engine section in upper portion of the tail (AVT Nov. 1972, p. 37). Retadyne is powered by two Napier Ghazal jet engines, each rated at 3,500 shp. Air from engines passes through axial blades, flows with fuel in low pressure portion.

compressor and engine components. Fuel quantity sensors at combustion control and fuel/air pressure indicators.

Engine and system is automatic and requires no controls. Section is dry pump type which lubricates all bearings by continuous oil circulation, except turbine bearing which is lubricated by induced oil from engine. Tank is mounted on top of compressor casing. Outputs in 14-4 parts.

• **System I.** Operates wing flaps, speed brake, ailerons and the fuel boost system, leading gear, nose gear steering, bridle. This is constant pressure system using porting in accumulator, reservoir, and recharging pump driven by lift air turbine motor.

• **System II.** Operates intake and elevator boost, right fuel boost pump, and, upon selection, may be used for wing flap and brake operation. Power for this system is derived in right air turbine motor. System contains reservoir but no accumulator.

• **System III.** Pressure porting is to provide hydraulic pressure for operation of fuel boost pump for initial engine starting. This need in emergency source of engine pressure when an ATM does pump is impossible. Pump is die cast turbine, connected in parallel with System I ATM driven pump. System I turbine pressure is 1,500 psi when operating on System III pump.

System III pump does not provide enough pressure to retract gear or flaps. But gear extension is automatic. Air plane's boost system will operate on either System I or II pressure, should one or the other fail.

Should the left engine fail with gear down, situation cannot be made. Only nose gear will retract, and flaps. Main

gear will be partially extended. Emergency gear extension is made via "T" handle on pilot's side of instrument panel. Gear will free fall, airflow will lock it down.

Lockheed set a production record by putting the jetliner into the air within 14 weeks. It did this by forming a systems unit, under Corporate Vice President Kelly Johnson and including it. Second prototype jetliner, N720K, at this writing is about to begin a series of nation-wide flight tests, stopping at military command headquarters.

### Liquid Fuel Engines Use Standard Parts

Main production techniques in the recently critical manufacture of liquid propellant rocket engines are utilized in manufacturing these powerplants by Rocket Motors, Inc., Dayton, N.J. Company says that design simplicity and standardization of components permits the tailoring of engine systems to meet requirements of diverse designs.

The regeneratively cooled propellant units, based on a simple design approach, achieve simplicity through the interchange of standard components. Specifications for components and subassemblies can be met by turning combinations of thrust chambers, injectors, and booster seats, chamber pressure, propellant combinations and other factors.

Engines are available in surveillance and flight data applications, but the active Alcoa claims that its cost is low enough to permit them to be used in expendable vehicles. In regard to cost, availability and performance, the new liquid propellant system are said to compare favorably with other engines.

**SOLID PROPELLANT ENGINEERS**

Advanced work in solid propellant rocket and space vehicle design have opened broad new fields for solid propellant rockets. Space Technology Laboratories has challenging positions in the field for engineers with five to ten years of experience in the design and development of solid propellant rocket engines.

Inquire regarding these positions are invited.

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# INFRARED AND ELECTRONIC WEAPONS SUBSYSTEMS



## RECONNAISSANCE AND SURVEILLANCE SYSTEMS

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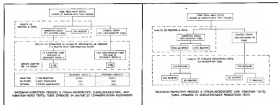
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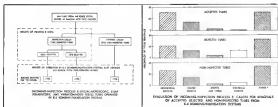
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## AVIONICS



PROCESS 1 resulted in scrapping about 25% of tubes in one evaluation. Process 2, method in scrapping of 66% of the tubes tested.



PROCESS 3 was used in another test with similar results of 17%. Tubes that passed were certified as working/acceptable systems.

## Tube Tests May Not Improve Reliability

By Philip J. Kim

Washington—Mitsubishi and other manufacturers who subject vacuum tubes to special tests and processing in the belief that this works out potential failures and signals improved reliability will be ignored by results of Defense Department investigations.

In conclusions, critics have shown special tube testing produces no measurable improvement in reliability, possibly the reverse effect.

Developing results are contained in new report by Aeronautical Radio Inc. Reliability Research Department which carried out investigations for the navy service. Army's report suggests that the conclusions also may be valid for special testing of transistors and other armor components.

Flowchart that special tube tests devised by some manufacturers have not improved reliability as much as they are expected to. Army, and reported by Aeronautical Radio Inc. (Nov. 20, 1971, p. 40). This hypothesis, resulting from Army's extensive reliability studies for Defense Department and the Air Force, concluded that with various of comparison using such procedures. At that time Army lacked sufficient data to prove its point.

**Concluding Evidence**

Evidence obtained during past two years is statistically controlled test is so convincing that the three manufacturers whose tube processing procedures were used as groups in the investigation have voluntarily discontinued them, says Army report. Other firms are following suit.

Army has no quarrel with companies that check performance of vacuum tubes to military specifications standards to which they are designed to work. The use of testing to full MIL-spec compliance using quality control sampling techniques. Army also concludes that special testing may have been performed a few years ago before quality of tubes had been raised to present levels.

Army acknowledges that some of the companies' special tests may be valuable for quality control purposes, but believes these should be conducted by the tube manufacturer on their prompt customer advice can be taken to tube design and/or manufacturing.

Have as a few of the findings of the Army investigation.

• **Process 1.** Comparing of two-stage manual acceptance inspection and a 10-hour same test, resulted in scrapping 65% of the tubes tested. Yet when

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the MARK I-A

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This proud new Learstar, built for Solo Cup Company, Chicago, represents another triumph in aircraft engineering. Combined are the high performance characteristics of both Learstar Mark I and Mark II. In every measure of safety, power, payload, cruising speed and range, the new Learstar Mark I-A matches the famous Mark I—yet it is offered at a greatly reduced initial cost. Fully loaded, with a crew of two, ten passengers, and 700 pounds of baggage, this new Learstar can travel coast to coast non-stop at a speed of 280 miles per hour. Learstars are the only business aircraft of intermediate range—the only business aircraft that match airline speed and range.

The new Solo Cup Learstar Mark I-A is another fine example of business aircraft engineered and produced with

a careful view of corporate economy. If you now own or contemplate operating business aircraft, it will pay you to investigate the advantages of Learstar—how this superior business transport compares favorably with other business aircraft, both in original cost and economy of operation. For complete information, telephone, wire or write:

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NEF "variable throat" valve assembly installed in LE-405/38 Mark I-A instrument panel



NEF circuit breaker installed in Solo Cup Co. specification instrument panel



NEF safety location pin installed in instrument panel

tubes which had passed tests were applied alongside non-passed tubes drawn from stock. 17% of the processed tubes failed, compared with 4.7% for unprocessed tubes. This marked vast difference in failure rates does not justify cost of tests and scrapage. Yours truly

• Process II, consisting of visual-thermographic inspection. Next and preliminary examinations plus selective case test, resulted in accepting about 75% of tubes in case evaluation. Processed tubes that passed were installed in AN/ARC-27 airborne DIME communications sets installed in Navy jet-type aircraft to have a similar number of unprocessed tubes drawn at random from Navy stock. After automated test of 1.5 million tube operating hours, Army found the unprocessed tubes actually had a slightly lower normal rate than those that had passed the thermographic inspection, i.e. 2.0% vs. 2.5% per 100 hr operation.

• Process III also was used in another instance with initial inspection of 17% of the batch. Tubes that passed were installed in K-band navigation systems flown in Air Force B-47s together with unprocessed tubes drawn from regular stock. After accumulated total of 1.5 million tube operating hours, Army again found that unprocessed tubes had slightly lower normal rate (0.72% vs. 0.75% per 100 hr).

Tens of millions of tubes, consisting of parts which had failed in pre-test or were of the special process II inspection batch but which were otherwise open type, also were installed in B-47 loads in various locations. Furthermore, this group achieved the lowest normal rate of all the three—only 0.55%. However, three cautions limit the number of tubes installed in the sample is too small to raise statistical validity. It therefore does not recommend use of test results for maximum reliability.

These non-inspection processing techniques, plus a final checking use of thermal shock procedures, were adopted



## Cold Plate

Heat generated by power transistors used in ground and airborne electronic circuits is dissipated by means of a cold plate which transfers the heat across a pressure thermal transfer to cooling air. This has been designed for Collins Radio Co. by United Aircraft Products, Inc.

# LEWIS

## Standard Temperature Indicators for Aircraft

USED BY LEADING AIR LINES, THESE INDICATORS HAVE PROVEN THEIR RELIABILITY BY YEARS OF SATISFACTORY SERVICE

### TEMPERATURE TYPE

All LEWIS thermocouple indicators are fully cold-lead compensated, magnetically shielded and are available for use with non-magnetic, copper-constantan or chromel-alumel thermocouples in all standard ranges for the thermocouple material used. A few typical ranges are listed below.

MODEL 115, 2½" case to ANS 10445  
—50 to +320°C Cylinder Temp.  
(AN 555A-1A or T1A)

—50 to +320°C Density Temp.  
0 to +1800°C Exhaust Temp.

MODEL 495, 3½" case to ANS 10445  
—50 to +320°C Cylinder Temp.  
0 to +1800°C Exhaust Temp.

MODEL 718 dual, 2½" case to ANS 10445  
—50 to +320°C Cylinder Temp.  
(AN 555A-1A or T1A)

—50 to +320°C Density Temp.  
0 to +1800°C Exhaust Temp.

### RESISTANCE TYPE

Accurate resistometers, these LEWIS indicators are remarkably free of voltage across, have nearly linear scales (not crowded at the ends) and are magnetically shielded. A few typical ranges are given below. See notes in Model 465, 3½" range.

MODEL 465, 3½" case to ANS 10445  
—75 to +115°C AN 575B or AN 5707T5  
0 to +115°C Oil Temp.

—50 to +115°C Oil Temp.  
MODEL 578 dual, 3½" case to ANS 10445  
—75 to +115°C AN 575B or AN 5707T5  
—150 to +350°F Oil Temp.

+150 to +350°C Cylinder Temp.

FOR MORE DATA USE LEWIS THERMOCOUPLES AND LEWIS WIRING WITH THESE INDICATORS  
**THE LEWIS ENGINEERING CO.**  
NAUGATUCK, CONNECTICUT

Manufacturers of Complete Temperature Measuring Systems for Aircraft

by Arinc as representative of those used by industry. Arinc carefully planned tests to minimize effects of external factors which might bias a fair comparison of reliability between processed and unprocessed tubes. Sample sizes were selected to provide statistically significant data.

Evaluation of Process A took place in the factory of the tube manufacturer that developed the technique, because of responsibility of obtaining data from actual manufacturing. Arinc used equal numbers of processed and unprocessed tubes of identical types which were installed side-by-side in the same equipment.

In evaluations conducted at Air Force and Navy air bases, processed tubes were installed in specified sockets of bombing or communications equipment in both the aircraft, unprocessed tubes in corresponding sockets of the other half.

Tubes removed during the servicing time were later analyzed to determine the reason for removal to see if there was any significant difference in types of failures between processed and unprocessed tubes.

In the case of the missile manufacturer using Process A, Arinc found that roughly 90% of the tube removals were for failure to meet required performance tolerances, which was due to inadequate circuit design rather than tube deterioration. Special processing tests for tubes could not correct this equipment design deficiency and this at best could only cut tube removals by 10%.

#### Tube Scrapping

Tube removals due to basic tube shortcomings (mechanical, electrical, metal bled from too thin unprocessed tubes, only two for the processed tubes. However, samples were too small to permit a valid statistical conclusion that tube processing pays off even here, Arinc believes. It questions the wisdom of scrapping some 1,500 in the typical processing run to reduce the number of tube defect removals from four to two.

Analysis of tubes removed from ARG-27s and Kibomung system during Process B, an inspection showed no significant differences in the types of tube faults between processed and unprocessed tubes, or between those which were rejected during processing runs.

Processed tubes used in ARG-27s experienced seven times as many heater defects as did the unprocessed tubes drawn from stock, but the heater replacement was less than 5% of the total tube removals. Heater defects also were slightly higher for processed tubes as noted from Kibomung in E-47.

On the other hand, processed tubes

## Simulator Tests B-58 Flight Controls



Complex B-58 flight control system is tested on full-scale mockup simulator at Ridge Power Division of Boeing Aviation Corp. Ten hydraulic lines are used to simulate each B-58 aileron, develop total torque of 240,000 in./ft. Amount of control surface deflection for given movement of pilot's stick is automatically varied over a 25:1 range in function of airspeed, air density and G-loading without pilot being aware of any change in stick feel. System includes automatic G-loading function which prevents pilot from overloading B-58's ailerons.



Complex power control linkage used in B-58 flight control permits pilot to superimpose manual movement on automatic stabilization, provides synthetic feel. Flight control amplifiers for a completely transpondered aileron 140 in. diameter, requires a release of 2.2 in. at 1000 pounds force to operate. Hydraulic function including aileron, Mach number control. Aileron has force response equal to more than 50 mm (AW, April 14, p. 18).



Measuring the bore of a steel liner ground in assembly with the flow housing of the Sikorsky S-6B helicopter transmission. Its diameter, three-welding rivets to the housing with all lines and hoses within the complete tolerance of plus or minus .001 and with inner tolerances of plus or minus .002.

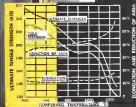
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expressed slightly lower than the expressed tubes from work, but the difference does not appear statistically significant, according to Arne.

Arne shows four possible explanations for the failure of special processing tests to successfully select out potential tube failures and thus to improve reliability.

- Unreliable measuring criteria. Test criteria used to determine which tubes are acceptable or unacceptable during special processing fail to duplicate accurately the criteria in which tube reliability is judged when tubes are used in aircraft equipment.

- Subjective testing lacks repeatability. Processing procedures which require human judgment, such as microscopic and X-ray inspection, lack uniformity and consistency. To illustrate this point, Arne cites investigation where a group of 672 tubes were run through microscopic inspection three successive times, without knowledge of the inspectors. During the triple inspection, 156 tubes consistently were passed at satisfactory, 144 tubes were consistently rejected, but 372 tubes received mixed appraisals.

- Tests may induce metal life. The stresses which result from handling and operation during processing tests may actually offset any gain from possible screening out of potential troublemakers.

- Screening does not solve design problems. The every equipment failure caused by an inherently defective tube, Arne believes there are between three and 16 reworkmen which should be attributed to tube defects which are in a word in defect by the way, the tube is applied in the aircraft. If special processing does improve tube reliability, this improvement is masked by the propagation of tube failures resulting from manipulation which are amplified by such tube screening.

### Transfer Unit

Although Arne's investigation was limited to vacuum tubes, it believes that the findings may be equally valid for special capacitors and silicon products used with other base components. The endproduct based toward using transistors, he created a critical need for a careful analysis of transistor problems and an objective evaluation of the special processing techniques used in solving the problem. Arne's report says "Gile in this way can in direct road meeting to the reveal of special tests which spring from extra test reasoning alone . . . (which) can be a costly disappointment."

Copies of the Arne report, Publication No. 127, may be obtained from Arne's Reliability Research Dept., 1700 K St. N.W., Washington 5, D. C.



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The instrument of the new NAVTAC air route navigation and instrument landing system by Stromberg-Carlson is an combination of functional capabilities.

The NAVTAC equipment is an assembly designed to provide high-performance aircraft with the TACAN navigation aid, plus marker beacon receiver, glide slope and runway location for instrument landing stations.

The entire system is packaged in a compact and only 8" high, 30 1/2" wide, 22" deep, and weighing only 47.5 lbs. Individual modules can be separated up to distances of several feet without any adverse effect on performance.

The equipment is designed to meet the rigorous environ-

ment of the high-performance aircraft at today and tomorrow. In operating ambient temperature range of -60 to +135 degrees C in altitudes up to 50,000 feet. Wideband use of semiconductor in the LSA receiver and TACAN receiver ensure high reliability, small size and low power consumption.

Included in the design is the capability of performing complete perfect maintenance tests with the use of a built-in test set.

Complete technical details on the NAVTAC system are available on request.

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ing, total to 22 purchased by Power General Controls' Electronic Controls Division has received Air Force contract for an advance air data computer system for use in military aerial fighters.

• **General Electric** Light Military Electronic Equipment Department and Philco Corp. have received Navy BuAer contracts for continued production of Subcarrier (radio-guided) anti-air missile. GE contract is about \$5 million, Philco's for about \$10 million.

• **Sperry Corp.** of America reports \$100,000 development award from Wright Air Development Center for what company calls "most advanced version of a military radar reconnaissance system" for use in high altitude reconnaissance missions. Company will build five systems under the contract.

• **Telecommunications Corp.** has received \$450,000 contract for self-controlled gyro for use in Bellhop reconnaissance module being produced by Martin's Orlando Division.

## Expansions, Changes In Avionics Industry

Catlin-Hamann, Inc., Milwaukee manufacturer of industrial control and aircraft radios, will acquire Aerobac Instruments Laboratory, Inc., Menlo Park, N. Y., if consolidation of both companies appears on May 20. Acquisition will be accomplished through a one-for-one exchange of Catlin-Hamann stock.

Other recently announced changes and expansions in the avionics field include:

• **United Electric Controls Co.**, Waterbury, Conn., has acquired Avionics Specialists, Inc., Glenview, Ill., producer of transducers. New subsidiary remains at present location.

• **Sperry-Hamann** has will move its research laboratory, Caltech, Calif., into larger quarters on 11,000 sq. ft. building, starting April 1. Laboratory will be being increased and will be divided into basic and applied research groups. Company's Sales/Service Division's advanced engineering department also will move to new facility.

• **Raytheon** Greenough Co., Santa Monica, Calif., has agreed move to new 100,000 sq. ft. facility, recently added.

• **Lockheed's Burbank Division** has moved into large building at 4675 Verdugo Ave., Burbank, Calif. Most plant moved at Glendale, Calif.

• **Radio Corp. of America** has formed new RCA Semiconductor and Materials Division which is responsible for engineering, manufacturing and marketing company's semiconductor devices and materials. Dr. Alan M. Clossy is general manager of new division, whose headquarters will be Secaucus, N. J., at plant of former RCA Semiconductor Division.

## Radio Noise Spectrum Concept Has Arctic Early Warning Value

Boston-New concepts of the radio noise spectrum, covering from cosmic to submillimeter gaps to cosmic static, have been developed at a national conference sponsored here by Harvard College Observatory under U. S. Army Signal Corps contract.

More than 150 scientists from industry, government and education attending the conference heard among the subjects discussed:

• **Acoustic reflections.** Radio and radar signals can be reflected by the atmosphere. These effects are being studied for immediate application to Ballistic Missile Early Warning System radar to be installed in the Arctic.

• **Radio noise from Jupiter.** Except for earth, the only planetary body so far discovered that is a source of radio noise other than single thermal noise in Jupiter which emits intense noise bursts varying both in time and frequency.

• **Solar whistles.** There has been advanced that the sun emits radio signals that are propagated along the lines of its magnetic field to a magnetic point in the opposite hemisphere in about the same amount as earth's whistles.

These signals are believed to originate from earth's magnetic field.

• **Radio noise from meteors.** As attempts to obtain correlations between atmospheric penetration by meteors and radio noise signals resulted in 10% correlation, confirming results of a Russian researcher who interpreted the fact that meteor produced noise. Further tests resulted in 10% correlation for meteors that did not intersect the receiving antenna beam, and 10% correlation for meteors that intersected the beam, making doubt an action as a source of radio noise.

• **Interstellar hydrogen.** Structure of the galaxy and large scale structure of the universe can be studied by determining quantity and nature of the hydrogen hydrogen gas that is a major constituent of the universe. These measurements can be made using the 21 cm radiation of hydrogen in its hyperfine transition, but the signals are very weak and would be blocked if they had come into us.

Study of the effects of radio and solar reflection from the aurora reveals considerable information regarding aurora under a contract from USAF's Rome Air Development Center. Most immediate purpose of the study is to determine problems that will be faced by radar of the Ballistic Missile Early

Warning System which will be installed in the Arctic area. Other effects on HF and VHF communications will also be studied.

Radio and radar signals at frequencies up to several hundred megacycles are reflected by ionospheric irregularities associated with the aurora. Scattering appears to take place at irregularities aligned with the earth's magnetic field lines. Reflected signals are subject to rapid fading and large Doppler shifts, and are also attenuated as they travel. A radio meets the magnetic field line nearly perpendicularly.

Noise received from planetary bodies can be described as either thermal or thermal. Thermal radio noise is simply the noise generated by free electrons moving through a medium. It has been observed from Venus, Mars, Jupiter, Saturn and the moon at centimeter wave lengths. Noise from some non equilibrium sources is called anomalous and, except for earth, the only earth-based source is Jupiter.

Non thermal radiation from Jupiter is apparently centered in the metric wave lengths, occurring in intense bursts lasting about one second or periods from a few minutes to one or two hours, varying both in time and frequency. The noise source is apparently contained in latitudes as the planet because the signals vary in addition to the period of rotation of the planet. Researchers at the Carnegie Institute of Washington who were performing the study attempted to find a relationship between the noise period and the solar-wind and spot, but none seems to exist.

Harvard College Observatory astronomers have offered a theory suggesting that radio energy emitted from disturbances on the sun's surface are propagated in the "whistler" mode and interact with earth's magnetic field as such a process that the effect itself is a major periodic fluctuation of the earth's magnetic field.

While earth whistles are propagated in the appropriate frequency range of from one to ten kilocycles, frequency of radio whistles would be much lower, perhaps a factor of 1,000, in the range from 0.1 to 100 cycles per second. Change in frequency would be very slow—on the order of one to three cycles every 15 min. Signals of this type are believed to exist and to have been associated with many radioastronomers.

Research looks on the subjects of radio noise from various and solar activity has been carried on at Harvard College Observatory.



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| Rolls Royce Dart              | Vickers Viscount • Fairchild F-27 |
| Rolls Royce Conway            | Boeing 707 • Douglas DC-8         |
| Rolls Royce Avon              | Boeing-707 • Convair              |
| Pratt & Whitney JT-5          | Boeing-707 • Convair              |
| Pratt & Whitney JT-5          | Boeing-707 • Convair              |

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## BUSINESS FLYING

### Air Fleet Furthers Jungle Bible Work

By Edwin J. Redban

Varied fleet of more than a dozen aircraft is plying the skies of a nation, its routes deep into the jungles of South America, compensating to approximately one fifth the time that would be normally required in using the modern methods of civilization to primitive tribes.

Flying portion of this operation is the responsibility of Jungle Aviation and Radio Service (JAARS) which provides the safety and communication needs of a widespread network of missionary hospitals of the Wildlife Bible Translators.

JAARS was founded in 1956 by W. C. Cason, Translated and incorporated as a non-profit organization in California. Through its affiliate, Summer School of Linguistics, the organization is dedicated to providing an accurate system of the Bible in the native languages of the more than 1,000 people who live in the way areas of the world.

In the past two years, JAARS' airplanes, ranging from a Piper Super Cub to a B-707, have flown the equivalent of more than 15 million passenger miles in the back jungle areas of Bolivia, Ecuador and Peru. Operations of Wildlife is guided by the airplane in their positive sense. According to the organization, "In jungle areas Wildlife cannot do better than JAARS."

#### Large Operation

This is one of the most novel large-scale aviation operations in the world consisting of more than 100 U.S. and Canadian pilots, many of whom are ex-military fliers who are also qualified in craft and engine mechanics. They work entirely without pay, to do all other members of Wildlife, to use an unusual and test drive by their friends. It is a non-profit organization, supplemented by a special fund of the organization as well as other outside aid is not sufficient to take care of minimum needs. It is estimated that a minimum of \$100,000 a month per year is required to take care of the "bird" work.

Most of the pilots get 40-60 flying hours a month. Despite the conditions and lack of money but the most basic aid, the organization has experienced only two crashes since its inception and in neither case were there any serious injuries.

Flying is primarily by time, dis-



JAARS' BULO COURIER at typical jungle landing strip, its short drop in lower soil

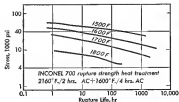


JAIF BUCK, with which JAARS started in 1946, on camp at Peruvian base.



ARONCA SEDAN supplies indigenous check of JAARS' Peruvian control base.





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Beechcraft scientists and engineers are at work on numerous projects involving transporting and storing of cryogenic liquids, plus projects in many aeronautical fields. A letter today to our Contract Administration Division will bring full information on how Beechcraft's five major plants, 1 1/4 million square foot of plant area, and 7,000 skilled craftsmen can help solve your research, development, or production problems.



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plying based at the start of lift-off. Crash safety features of the Cassini, which is especially designed to maintain structural integrity of the cabin in event of an accident, is also a big factor in choosing the airplane. Most projects noted new risks, in which the risks far exceed those on lift-off and the plane was considered. Cassini was upgraded, also, he said, the cabin doors opened as easily as they would normally, indicating that the structure needed no work.

Only major problem encountered thus far with the Cassini has been overhaul life of its Locomotor G4-415, according to JARS's assistant superintendent. Collectors wouldn't last over 500 hr., although they were supposed to go for 600 hr., he said, and even the Locomotor couldn't fix the problem. So JARS is choosing to replace its Cassini engine cylinder and expect to get at least 1,150 hr. on the, although they should go 2,000 hr. with this treatment he noted. Management pointed out that they have no similar problem with other aircraft.

#### Types of Operations

Major part of JARS's strong operations with a strong language specialists trained by the Summer School of Languages, comprising a family, associated with small children, sometimes a part of young girls into the jungle to live with the primitive tribes for six months at a time, in order to study their dialect first hand and attempt to create an accurate grammar in order that the language can be translated into the Scriptures and that native teachers can be indoctrinated.

Airplanes also fly all the national needed by the team, including food, medical supplies and the vehicles in the equipment. A JARS' airlift brings in other necessary gear, and sometimes produce, per-cold refrigeration, and occasionally brings out the sick and reveal where necessary. Probes in for the look right to month, take in two translation with two weeks' supplies in one flight then immediately make return flights to build supplies to a three-month level. Then if necessary, are contact with each camp at least once a month.

At the end of the half year, the translators are brought back to the base camp to work as the material they have collected. They spend perhaps six months on this and then return to the tribes for additional periods as long as the job requires.

JARS' projects are also used by many other people traveling in these areas, including members of other missions, or religious groups, Peace Corps technicians, scientists and relief and foreign missions having business in the area it operates. In Peru, for example,



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it is shunted by the air force robbery at transport service to provide air service where there is no other way of getting around. Surface travel is so difficult it can take three or four months to reach some areas, while an airplane gets to the same place in hours. When persons not belonging to the Wyldlife organization are denied the charter, consider them well versed in the art of accident, usually JAARS carries no insurance on either its equipment or personnel.

Occasionally JAARS also supplies charter service to some companies working in the area. In one case it operated a petroleum company's Catalina for several months when that firm's pilots weren't handy for the job. For a nominal fee of \$125 a month, Marquardt provided considerable flying over mountainous terrain.

#### Fuel Consumption

JAARS operations last year consumed some 45,000 gal. of aviation gasoline—91 acres in standard 100-amp FBT is often used as a tanker to replenish gas caches along the river in the area the organization operates. Production is to fill the Catalina with 1,116 at 1,200 gal. of fuel, does all required work at the various caches. Catalina is useful in flying heavy loads long distances. In Bolivia, for ex-

ample, it was possible to set up a base with only two flights in the FBT, saving an estimated three years in getting material to the spot.

#### Devoted Equipment

Some equipment is, like devoted, but most is purchased by JAARS but not from surplus stocks of inventory. In the case of the Cessna 180, the story is that a pilot-owner couldn't sleep one night because he feared the bird might be lost. One Wyldlife pilot chose of the Cessna 180 was told an owner they was the company. And the purchase made the other in Wyldlife, which had enough funds to buy the remaining half ownership.

JAARS owner is tough. "We put God on the spot and he delivers." Only a little more than a year ago it owned two Helio Coronas—it now has a half-down, expects to get another soon and is considering to get more of the \$25,500 STOL, replaces for operations in the Philippines and New Guinea.

When it receives reliable funds from a company's group to purchase an aircraft, produce it is near the airplane after that time. The Corona

## To Controls Engineers Facing an ENGINEER BARRIER\*



By  
Roy E. Marquardt,  
President

Marquardt was established in early 1946. Concurrently with the early development of the rocket engine, controls had to be designed which would operate within the engine engine under severe environmental conditions.

The extreme velocity and acceleration of the engine control systems requirements will beyond the limits of the technology then in development and operation.

Marquardt engineers and scientists solved these early controls problems... creating assemblies which produced reliable performance in the high Mach regime, and today under Chief Engineer Tracy Kramer have gone on to develop a family of ever more advanced controls and accessories.

In rotating assemblies, Marquardt's pioneering turbine and pump work has advanced in emergency power units for the Chance Vought F4U-1 Crusader, and the Lockheed P-106 Star Fighter.

In the case of engine engine engine, Marquardt engineers and scientists have been engaged in broad research and development programs for the past ten years. This aerothermodynamics knowledge coupled with our controls background has led to applications for variable geometry inlet control systems on North American's B-57D electronic countermeasures missile and McDonnell's two-engine all-weather fighter.

And in afterburner controls, carburetors, noise suppression and nuclear systems, Marquardt engineers have and continue to achieve significant engineering breakthroughs.

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*Roy E. Marquardt*

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Steve Lee—A.J. Zivian—Chief Engineer  
Controls & Accessories Division

\*ENGINEER BARRIER—an achievement level beyond which you cannot advance



#### Monte-Copter Flies New Configuration

Latest version of postmaster powered Monte-Copter, shown during test flight at Boeing Field, Seattle, Wash., has completely revised fuselage and new tail. Earlier prototype (SAW Mar. 51, p. 88), was converted, reduced twin barrel tail surfaces. Two Cessna 140-40 hp engines are mounted in pods on each side of fuselage.



These weather items prepared in consultation with the United States Weather Bureau

## TEMPERATURE VARIATIONS

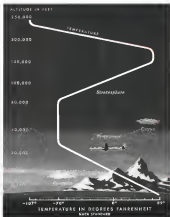
IN RELATION TO ALTITUDE...

**TEMPERATURES encountered** in a single flight may vary as much as 150°F or more. These variations are associated with altitude and weather patterns and can affect flight performance.

**Temperature and altitude**—Near from the earth, warm the atmosphere with steadily decreasing effect as altitude increases. Temperature normally decreases with altitude at the rate of 3½°F per 1000 ft. At the tropopause (top of troposphere) temperature remains almost constant up to 40,000 ft. Therefore, modern aircraft encounter colder air in the tropopause layer which varies from about 20,000 ft. at the polar air masses to 54,000 ft. in the tropical.

As altitude increases from approximately 80,000 ft. to 150,000 ft., the temperature remains in almost sea level conditions. That is the result of strong absorption of the sun's ultra violet rays in the layer of ozone gas at very high altitudes.

At still higher altitudes, the temperature becomes so extreme cold.



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Instant control response can be yours despite extreme temperature variations, thanks to the wide range of temperature characteristics of these top quality Mobil products.

**Mobil Aero Hydraulic Oil HF and HFA**—These low pour point and high VI oils help assure trouble free operation of hydraulic control systems, brakes and axles through all temperature ranges.

**Mobilgrease Aero Lo-Temp and General Purpose**—These Aero greases help assure smooth operation of all sliding and rolling surfaces of aircraft parts... control systems, bearings, and gears.

of its Latin American Inter-American Friendship Fleet, for example, are named "City of Chicago," "Spirit of Kansas City," "Friendship of Orange County, Calif.," etc.

Organizations place bids of the airplanes in the name of the governments where it is operating to demonstrate its cooperation, which aids in cementing ties of friendship. Many of the governments cooperate to the extent of their limited resources, last year the Panama government donated 40,000 gal. of fuel to PAARS.



YAK-18P has top speed of 174 mph

### Russians To Produce Yak-18s in Quantity

Two new versions of Russia's single-engine Yak-18 trainer have completed flight tests and are slated for quantity production.

Both planes—the Yak-18P and Yak-18A—encompass substantial improvements in design and performance over their prototype. They will be delivered to the Red Air Force and to army units operated by the U.S.S.R.'s army, naval aviation (VVSMA) (Volunteer Scouts for Cooperation with the Army, Air Force and Navy).

Prototype Yak-18A has a maximum speed of 161 mph, at sea level, service ceiling of 16,000 ft. and service range of 400 mi. With standard fuel tanks, range can be increased to more than 2,400 mi.

Major parts of the Yak-18A, according to Soviet reports, is in large scale of climb. It can reach 3,281 ft. in 30 seconds. Maximum speed and maneuverability are better than for the Yak-18.

Single-seat Yak-18P has a top speed of 174 mph and service ceiling of 21,982 ft. Takeoff run is 704 ft. and landing distance along braked and flaps is about 516 ft.

Yak-18P's tandem landing gear is fully retractable, while the Yak-18A's is only semi-retractable. Both craft are low-wing monoplanes powered by air-cooled, radial engines. They have two-way radio and all-weather navigation equipment.

### VERTICAL TAKE-OFF...

... a new Landmark of Aviation Progress



Bell Aircraft now presents the opportunity to be associated with the development of high-performance, jet aircraft which will take off and land vertically in a conventional attitude. Two test vehicles, one of them the X-14, have been flown successfully, and an operational aircraft is now being designed for the United States Navy.

Expansion of this VTOL program has created openings for experienced aerodynamicists and structures engineers with experience in these fields:

- Structural Design and Analysis
- Flutter and Vibration
- Flight Control Systems
- Propulsion Systems Design and Analysis
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Here are challenging, long-range opportunities to participate in the production of the planes of tomorrow. Selective communication with your background, good living and working conditions, and liberal benefits. Please write, Supervisor of Engineering Employment, Dept. E-25, BELL AIRCRAFT CORPORATION, P. O. Box 1, Buffalo, N. Y.



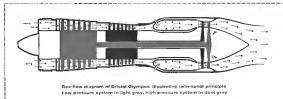
BRISTOL: Power for the Wings of the World—No. 4

# BRISTOL OLYMPUS

POWERS THE

# VULCAN

**Twin-spool Olympus gives British V bombers great speed, high ceiling, long range**



Side-view diagram of Bristol Olympus illustrating twin-spool principle  
Low-pressure system in light grey, high-pressure system in dark grey

The great Avon Vulcans of the British Royal Air Force are powered by Bristol Olympus turbojets. These V bombers owe their great speed, high ceiling and long range largely to the Olympus—an engine which uniquely combines great power at high altitudes, very low specific fuel consumption, and exceptional, proven reliability.

The British Under Secretary of State for Air, Mr. Charles F. Oxley, has stated: "The Vulcan has probably had the minimum amount of teething trouble of any aircraft introduced in the RAF over the last 15 years."

**Bristol twin-spool system.** The Olympus employs the Bristol patented twin-spool system. This system makes steering easy, eliminates surge, and gives a rapid response to control. Vulcan pilots regularly put the Olympus through "shock" accelerations and decelerations at altitudes well above 50,000 ft—use of the most severe tests to which a turbojet can be subjected. The Olympus responds magnificently every time.

**Latest version.**—the Bristol Olympus Mark 200 is type tested at 25,000 lb. thrust—without reheat. It is now in production for the Vulcan B Mark 2 and gives this bomber even better performance. A first version of this turbojet—the Wright TJ 58 Zephyr—has been jointly developed by Bristol and Curtiss-Wright.

**Olympus development.** The Olympus is capable of development into the 30,000 lb. thrust class. It has already run at observed thrusts of over 17,000 lb. without reheat.

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FOR COMMUNICATIONS

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**PUSHER** propeller has rescue action

### Russian Snow Sled Uses Aircraft Engine

A propeller-powered Russian air sled built in helicopter design N 1 Kamas for surface transportation over snow and ice in the far north has not only been completed in form.

Vehicle consists of a standard Soviet Polaris automobile-engine, wheel-mounted on runners. On top of the car body is a 200-hp Al 14H piston engine—the same propeller sled is Russian new Aviaton An 14 Polaris (Little Bear) short-haul airline transport plane.

A two-bladed, variable-pitch pusher propeller provides forward motion and braking. If necessary, the propeller can furnish reverse thrust for backward movement.

Russian reports state that the Kamas is not a more powerful than similar vehicles built earlier "which didn't provide even minimum comfort, were short lived, and had more operational troubles." The Kamas model is said to be as comfortable as a passenger car and can be operated by anyone familiar with an automobile's controls.

Space internally intended for the automobile engine is used for baggage. Loads with a fuel capacity sufficient for five-hour operation are located under the car's front fuselage.

Sled is equipped with a special heater vent to warm the engine before starting.

It also heats the car's cabin "when freezing and can warm the engine inside of the runners if they should become frozen while the vehicle is stopped."

### PRIVATE LINES

Test program for Russia's two-engine Aviaton An 14 Polaris (Little Bear) short-haul transport calls for approximately 33 flight hours. An 14 made its first flight in mid-March (NAV Apr. 21 p. 45). Standard version will carry six passengers and 750 lb. of baggage for 775 mi.; a proposed cargo model will carry 1,300 lb. payload up to 625 mi.

Executive version of five-seat T-77 helicopter transport are now scheduled to go to following Contractual Co. Co. General Tire & Rubber Co., Bell for Aviation, Bank of Mexico, Western Electric Corp., Clouston Sports, Pilsa Co., Kirschke-Cook, Corp. and Ideal Carpet Co. In all, 15 firms have ordered planes for private use. Fanchell has total of 45 orders on books for R-27s, including airline types.

Half-dozen separate aerial survey contracts covering some 60,000 sq. mi. of Bolivia have been awarded Consales Hunting Group by several international oil firms. Amount of contracts exceeds

\$750,000, calls for aerial photography, photogrammetric mapping, seismic data control, airborne magnetometer surveys and other interpretation. Hunting is employing a Boeing B-17 photo ship and two Lockheed Hudson converted with magnetometer and photo gear.

Three Vertol 44 helicopters have been purchased by Canadian government at cost of approximately \$1 million, with spares. Vehicle will be turned over to Spartan Air Services Ltd. which is handling supply of Mail Canada Ltd. Winnipeg Line satellites for the RCMP contract.

## AIRWORK Opens A **NEW** Accessory Overhaul Shop... In Miami



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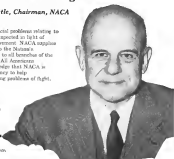
## A message for young physical scientists & engineers

from James H. Doolittle, Chairman, NACA

Future breakthroughs on crucial problems relating to aircraft and missiles can be expected in light of NACA's long record of achievement. NACA supplies advanced research findings to the Nation's aircraft and missile industry, to all branches of the military, and to the airlines. All Americans can be assured by the knowledge that NACA is working with a spirit of urgency to help solve the current most pressing problems of flight.



James H. Doolittle



James H. Doolittle, Chairman, NACA;  
Dr. D., Massachusetts Institute of Technology

NACA has a staff of 7,750 research scientists and supporting personnel spread among centers on both Coasts and in Ohio. NACA staff members in pursuit of new knowledge have available the finest research facilities in the world, including several of the largest and finest supersonic and hypersonic wind tunnels, jet jets, a fleet of full scale research airplanes, which will include the X-15, hypersonic bolt-on engines, shock tubes, a machine room establishment, rocket facilities, a research missile launching site, tracking devices, and the most advanced mechanical and electronic computers.

NACA Fields of Research include Aerodynamics, Aircraft and Missile Structures, Materials for Aircraft and Missile, Automatic Stabilization, Propulsion Systems, Propulsion Systems Structures, Rocket Systems, Solid State Physics, Fluids, Instrumentation.

A member of staff openings are becoming available. You are invited to address an inquiry to the Personnel Director at any one or all four of the NACA research centers:

Langley Aeronautical Laboratory, Hampton, Virginia  
Ames Aeronautical Laboratory, Mountain View, California  
Lewis Flight Propulsion Laboratory, Cleveland, Ohio  
High-Speed Flight Station, Edwards, California

(Positions are filled as vacancies arise with the Government Research Service Appointment Plan)



The Nation's Aeronautical Research Establishment

## WHO'S WHERE

(Continued from page 27)

### Changes

John Cary, manager newly established Transport Section, Support Department, North American Aviation, Inc., Los Angeles, Calif.

Edwin A. Roney, manager, Dynamics Division, West Research Corp., El Segundo, Calif.

Chas. Bishop, manager, Pacific Aeronautics Corp.'s aviation products branch, Berkeley, Calif.

Gordon E. Mikesque, manager, propulsion staff Polaris project, Missile Systems Division, Lockheed Aircraft Corp., Sunnyvale, Calif.

Selby J. Nelson, aircraft flight operations, and Walter R. Roney, senior flight engineer, Transcon Air Lines.

R. A. Goff, Washington, D. C., district representative, Southland Aviation and Engineering, Turin Division, Southland Machine Tool Co., Rockford, Ill.

Peter H. Wood, engineering director, Van American World Service for Veterans.

John E. Campbell, manager personnel sales, Continental and Industrial Division, Fluoro Corp., Philadelphia, Pa.

Bar Adas, Ford Nuclear Turbine, Inc., (FNT), c/o J. J. Jacobs, Washington, D. C., operations, Philbald Chemical and Instrument Corp., Sausalito, N. Y.

Hugh A. Young, sales manager, Telsco, c/o Products Division, Philbald Electronic Corp., Los Angeles, Calif.

Col. J. G. Markon (USAF, ret.), and consultant, National Research and Development Corp., Wichita, Kan.

Richard C. Zinn, assistant branch manager, Lockheed Aircraft Service International, New York International Airport, N. Y.

Edna A. Wilson, assistant to branch and sales manager, Missile Application Department, Lockheed Industries Division, the Electric Storage Battery Co., Philadelphia, Pa.

Ray S. Blumstein, assistant general manager, and Martin W. Givings, representative and development engineering manager, Aero-Dynamics Laboratories, Manufacturing Co., Pacific Coast, Mich.

Dallas A. Murphy, spare parts process and engine commercial aid manager, sales Production Expense Department, Aero-Dynamics Division, General Electric Co., Cincinnati, Ohio.

H. David Blum, manager industrial sales, and Arthur G. Chas, manager contracts sales, TTE Cement Division Co., Philadelphia, Pa.

W. S. Green, chief manufacturing engineer, Turbomec Products Division, Westinghouse Corp., Los Angeles, Calif.

Marvin Roney, senior mechanical engineer, Wright Engineering Co., Van Nuys, Calif.

Ray Geo Samuel S. Jack, Director of Division at Headquarters Marine Corps will move to Marine Corps Air Station, El Toro, Calif., as Deputy Commander, 4th, Fleet Marine Force, Pacific, Maj. Gen. John C. Mendenhall, Commanding General of the 1st Marine Aircraft Wing at Cherry Point, N. C., will replace Gen. Jack as Director of Aviation.

## Engineers: work in dynamic science

North American's Columbus Division, home of the T2F jet trainer, F4-4 Fury Jet and A-1H attack weapons system, is rapidly expanding its Dynamic Science Section. New aircraft, missiles, and research developments have created excellent career opportunities in these fields:

**AERODYNAMICS:** Work entails making comprehensive studies in analytical flutter and vibration, evaluation of preliminary designs to determine from an aerodynamic standpoint the effects of structural flexibility on aero load distributions.

**DYNAMIC TESTING:** You'll be engaged in testing models in laboratory and wind tunnel, determining the effects of ground and flight vibration on complete systems, and measuring flight vibration in reproduced environments.

**DYNAMIC ANALYSIS:** Performs studies on the effect of anti-blunt, and carrier operations on the structural system transient loads. Apply a generalized harmonic analysis to random disturbance on rigid bodies. Ascertain the effects of flexibility on structural response characteristics.

**ANALOG COMPUTING:** Work on the development of analog techniques, circuits, methods...combine analog-digital operations by applying differential analysis techniques.

Applicants with at least one degree and related industrial experience are invited to write or apply to:

Engineering Personnel  
North American Aviation, Inc.  
400 East Fifth Avenue  
Columbus, Ohio

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**POWER PLANT DEVELOPMENT** Degree in Aerospace or Aerospace Engineering with 3 years experience in turbine engine development or field engineering applied. Position entails developing specifications for design of new aircraft Power Plant installations and related systems including operation of turbine engine plants for design improvement and delivery correlates with turbine performance of specific aircraft models.

**PROPULSION ANALYSIS** Degree in Aerospace or Aerospace Engineering with 3 years experience in structural analysis including structural analysis and aerodynamic theory. Advanced degree with aircraft and astronautical engineering experience desired. Assignment will involve planning the realization of new engine model installation in the solution of aircraft air flow operation and performance problems.

**AIRPLANE PERFORMANCE** Degree in Aerospace or Aerospace Engineering with 3 years experience required. Should be familiar with computer program GASP for performance and must have sound experience in determination of flight test data with emphasis on airplane performance. This assignment involves prediction of airplane and engine performance data and development of improved flight operation flight test.

For further information send details of your education and experience to:

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**AIRCRAFT INTERIOR DESIGN** Degree in Industrial Engineering with 3 years experience in aircraft design or design of aircraft interior systems. Assignment entails development of specifications for new aircraft systems, and use of system and component operation and evaluation of portions by design systems in terms of simplicity and maintenance convenience.

**STRUCTURAL ANALYSIS** Degree in Aerospace Engineering with 3 years experience in the design of structural systems for aircraft components and systems. Experience in design of hydraulic and pneumatic test equipment for dynamic characteristics and design and development of specifications for dynamic tests of equipment and correlation with system characteristics in development problems.

**ELECTRONICS** Degree in Electrical Engineering with 3 years experience in design of electronic systems and equipment including flight control and electronic control systems. This position involves system analysis and correlation data and the operation of a flight test.



## ENGINEERS, E.E.

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If your field of special competence appears in the 24 below there may be a position open to you, with high professional development for the future.

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Positions are at various levels, S.T. included.

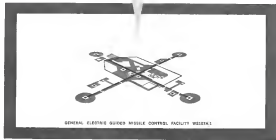
Please address your resume to: Mr. R. A. Smith, Dept. S-11

If your qualifications approximate job "space," we will arrange a convenient interview.

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# How **ESNA**<sup>®</sup> solves 7 typical aircraft fastening problems



## Speedier installation of access panels

ESNA gang channel nut strips eliminate the costly, time consuming installation job of riveting individual nuts. Available in straight or curved sections and even complete rings, custom designed for applications such as access doors or inspection covers.



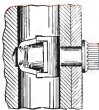
## Bolting non-parallel surfaces

No more costly spot facing, step milling or hand selecting tapered shims! ESNA's counterbored, self-aligning types include one lug, two lug, gang channel, standard hex and high tensile types. Ball-and-socket relationship of nut and special base allow an 8° tilt in any direction from centerline to compensate for draft angle or tapered sections.



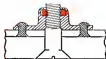
## Fastening stressed joints subject to temperatures up to 1300°F.

For really "hot" applications such as jet engine flange assemblies or fire wall sections, where fastener dependability is critical, ESNA offers the "long-beam" locking device. The full cantilever of these sections assures protection against failures related to relaxation, creep and similar problems caused by the effects of extremely high temperatures upon metals. (Ask for ESNA Bulletin No. 5715 Design Manual for High Temperature Self-Locking Nuts.)



## Simplifying major substructure joining

An ESNA barrel nut doesn't have to be held for wrenching. . . doesn't need precisely mated bolt holes. The barrel-shaped fastener, is simply finger-pressed into a drilled or reamed hole until the special clip snaps into position at the bolt hole location. The .030" float of the nut section of this fitting avoids misalignment problems and the bathtub recess for wrenching area is eliminated. New NAS 577 barrel nut (180,000 psi) now available. Also 160,000 and new 220,000 psi series.



## Applications requiring guaranteed high reusability through more than 50 on-off cycles.

Where repeated tear-down and re-assembly or frequent readjustment is required, the exceptional elastic "memory" and non-galling characteristics of ESNA's standard nylon locking insert guarantees long lasting locking torque and fastening dependability. Available in all sizes and configurations of standard aircraft type nuts. Parts can also be designed to order and in any standard configuration, with guaranteed re-use factors as high as 300 on-off cycles.



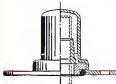
## Attaching components in areas with limited wrench clearance.

Miniaturized insert-type hex nuts with across-the-flats dimensions as small as .109 in the 0-80 size . . . or all metal (550°F.) nuts to AN365 or NAS 679 performance specifications with internal wrenching hexagon faces (which permit use of smaller wrench sizes) are available for use at locations where space and weight limitations are paramount. Complete lines of NAS miniature anchor nuts in carbon steel and A286 stainless steel are also in production. Ask for your copy of the NAS/ESNA Conversion Book.



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No danger of highly volatile fluids leaking past bolt threads with ESNA's self-sealing, floating anchor cap nut! The one piece cap unit is provided with "O"-ring seal around its base which seals immediately the nut is riveted to the surface. The self-locking nut enclosed within the cap has .025" float to compensate for misalignment. Also available in gang channel nut strips.



## —WHAT ARE YOUR FASTENING PROBLEMS?—

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| <input type="checkbox"/> Fitting in limited space      | <input type="checkbox"/> NAS/ESNA Conversion Book                         |
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